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BONE AND JOINT LESIONS OF YAWS WITH *X*-RAY FINDINGS IN TWENTY CASES*†

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WHILE attending the clinical course of instruction of the graduate school of tropical medicine and public health of the College of Medicine and Surgery, University of the Philippines, during the 1916 session, my attention was directed to the study of the painful bone and joint involvements occurring in some cases of yaws. This complaint prevailed among a great number of patients that were subsequently seen in the barrios of Las Piñas and Parañaque.

Through the courtesies of Doctors Luis Guerrero, Domingo, and Argüelles arrangements were perfected by which a group of one hundred cases of yaws was collected for study.

My work was confined to the cases of suffering from bone or joint lesions. Any one who has attempted such a work among Filipinos realizes that there are certain limitations in obtaining reliable information that might materially affect one's conclusions. The first month of the work was spent in gaining the confidence of the patients by frequent visits to their homes, by furnishing free medicine, and by assuring them of no inconvenience and of a cure of the disease.

The diagnoses of these cases were made by the histories, by the clinical symptoms and manifestations, and by the demonstration of *Treponema pertenue* under the dark-field microscope in the cases where an open lesion was present, and by a careful history of those without open lesions, so as to remove any doubt as to the diagnosis.

Twenty per cent of the cases of this group of patients, as they presented themselves for treatment, suffered from bone or joint lesions. These patients were persuaded to come to the Department Hospital, Manila, for *x*-ray examinations and treatment. A roentgenological survey of all the bones of the body was made of each case, regardless of whether or not the patient complained of pain in the part *x*-rayed. Subsequent roentgen ray plates were made, in order to follow the progress of the lesions under treatment.

In the majority of cases the lesions show as rarefied areas, irregularly oval or elliptical in shape with the long axis parallel to that of the bone in which the lesions are located. The size varies from the smallest discernible area to one that is two or three centimeters in length. The rarefication presents moderately well-de-

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fined borders separating it from the unaffected bone and varies in translucency from the slightest differentiation of unnatural transparency to one simulating a perforation. Most of the lesions appear to originate in the interior of the bone, while a number can be seen as small excavations on its outer surface. When the lesion is on the surface of the bone, the periosteum is usually destroyed, but occasionally the cortex shows thickening, and the periosteum is separated from the bone. In two cases of this series there is a general thinning of the cortex of the bone and a loss of the cancellous-tissue appearance. About two per cent of the cases show a nodular type of lesion, evidenced by swelling over the surface of the bone, with a localized thickening of the cortex, which sooner or later in the course of the disease shows rarefication in its center.

In the chronic lesions marked irregularity of the bony outline is evident, and the picture characteristic of the earlier lesions is more or less lost. The bone as a whole becomes deformed, and the growth of the bone is interfered with both in length and breadth. This dwarflike picture is most frequently noticed in the cases showing the lesions in the epiphyses. Within the joints the destruction is most frequently seen on the parts of the articular surfaces most exposed to trauma, as oval or irregularly shaped excavations, making the outline of the articular surface rough and uneven. It is concluded from this series of cases that the joint pains complained of are due in most part to the presence of the lesions on the articular surfaces.

With the exception of the 2 per cent of cases showing as a swelling over the surface of the bone, the roentgen ray picture is different from the bone lesion of syphilis, in that: (1) The periosteal proliferation is absent, and (2) the thickening of the cortex of the bone is absent. Also, in the 2 per cent of cases where thickening of the cortex is present, the thickening remains localized, does not tend to extend along the whole length of the bone, and sooner or later shows rarefication in the center of the lesion.

The bone lesion of yaws may simulate (1) tuberculous or septic central abscess, (2) gumma, (3) hydatic cyst, (4) benign cyst, (5) fibrous osteitis, (6) enchondroma, (7) endothelioma, (8) secondary carcinoma, (9) myeloma, and (10) sarcoma. The differential diagnosis can be made only by combining the radiographic appearances with all clinical data, including the history, physical signs, and evidence of disease or tumor in other parts of the body.

Summarizing the findings in Table I, it is seen that in 20 cases of bone lesion in yaws:

1. The shaft of the bone is the most frequent location of the lesion and shows involvement in 80 per cent of the cases.
2. The epiphyses or articular surfaces are involved in 20 per cent of the cases.
3. The tibia is the bone most frequently involved (40 per cent of this series).
4. The order of frequency of occurrence of the lesions in the other bones is as follows:
   (a) Tarsal bones, 40 per cent (75 per cent of these lesions occur in the os calcis).
   (b) Fibula, 35 per cent.
   (c) Phalanges of feet and hands, each 30 per cent.
   (d) Metatarsal bones, metacarpal bones, and radius, each 20 per cent.
   (e) Patella and humerus, each 15 per cent.
   (f) Femur and ulna, each 10 per cent.
   (g) Carpal bones, ribs, sternum, and pelvic bones, each 5 per cent.
   (h) In the bones not mentioned no lesions were found.
5. There is no constant relation of the location of the external lesion to the bone lesion.
6. The order of frequency of occurrence of the lesions in the joints is as follows: Knee, finger, ankle, and elbow.
7. The lesions are multiple in 75 per cent of the cases, the greatest number being one hundred thirteen.
8. The time between the appearance of the primary lesion and bone lesions varies

from six months to nine years, with an average of two and eight-tenths years. In this series 45 per cent of the cases showed bone lesions one year; 15 per cent, two years; 5 per cent, three years; 10 per cent, four years; 5 per cent, five years; 15 per cent, six years; and 5 per cent, nine years after the appearance of the mother yaw.

Fifty per cent of the cases of this series were under fifteen years of age; 75 per cent, under twenty years of age; and 90 per cent, under thirty years of age.

In the observations made by McCarthy,[17] in 1906, on the prevalence of tertiary lesions in defined localities and among certain classes of people, he gives the frequency of their occurrence and their description as follows:

"1. Chronic thickening of the skin on the palmar surface of the hands and soles of the feet.—The fissures in cases extended only partially through the skin, were painless and dry, and caused no further discomfort than a feeling of uncomfortable roughness over the affected parts.

Table 1.—Site of lesion, bones involved, interval between appearance of primary and bone lesions, and ages of patients in twenty cases of yaws[a]

	Case No																			
	1	2	3	4	5	6	7	8	9	10	11	12	20	21	22	23	24	25	30	31	Total
Phalanges of hand	1		1			1		1										1		1	6
Metacarpus	1		1					1							1						4
Carpus			1																		1
Ulna			1					1													2
Radius	1		1				1	1													4
Humerus			1					1											1		3
Scapula	1																				1
Sternum																1					1
Clavicle																					0
Ribs			1																		1
Vertebra																					0
Pelvic bones			1																		1
Femur			1					1													2
Tibia	1		1		1	1		1				1		1	1						8
Fibula	1	1	1					1						1	1			1			7
Patella	1		1					1													3
Tarsus			1												1						2
Os calcis		1			1				1				1		1		1				6
Metatarsus	1		1	1								1									4
Phalanges of feet	1		1				1	1		1	1										6
Shaft	1	1	1	1	1	1	1	1		1	1	1		1	1			1	1	1	16
Epiphyses	1		1					1							1						4
Total lesions	10	5	52	2	2	10	8	113	1	1	2	2	2	6	18	1	1	2	1	2	4
Appearance of primary lesion	1909	1915	1911	1915	1914	1915	1911	1916	1911	1915	1909	1916	1912	1912	1905	1905	1910	1913	1910	1915	
Appearance of bone lesion	1910	1916	1912	1916	1916	1916	1912	1916	1914	1917	1915	1917	1916	1917	1914	1907	1916	1917	1916	1916	
Years between appearance of primary and bone lesions	1	1	1	1	2	1	1	½	3	2	6	1	4	5	9	2	6	4	6	1	62.8
Age.....years	7	10	15	7	23	50	28	27	16	7	36	7	15	17	14	18	14	5	19	8	

[a] Each individual bone has been tabulated but once under its respective heading, whether or not the lesion appeared in the same bone on the opposite side of the body.
[b] Average of years between appearance of primary and bone lesions.

"In others, the cracks extended down to the muscular layer, exuding a sero-purulent discharge and were extremely tender on pressure. The sensibility of the surface of these parts is greatly diminished.

"2. Chronic indolent ulceration of various parts of the body.—These ulcers varied in size from small ones to those of the size of a hand or larger. When not associated with periostitis, the ulcers are painless and heal slowly. When multiple, the general health is greatly impaired, anemia and emaciation set in, and chronic invalidism is caused. Ankylosis caused by cicatricial contraction of extensive ulceration on the flexer aspect of joints has been observed in several cases.

"3. Periostitis and osteitis are other sequelæ frequently seen.—The shaft of the tibia, radius, and ulna are the usual sites of these complications. A swelling resembling a syphilitic node, appears over the shaft of the bones involving all the tissues covering it. This is at first painless. As the growth enlarges, the bones become thickened and the surface of the skin is glazed and purplish, and pain on pressure is present. The skin in time breaks down and troublesome ulceration results. When joints are affected, usually the knee, finger, and elbow-joints, with this variety of the disease, ankylosis results.

"Necrosis of the nasal and palate bones resembling the syphilitic affection of this nature, have been seen in several cases.

"4. Cartilaginous tumors on the elbow and knee joints have been observed in nine cases. These tumors were painless, and caused no discomfort except for their size and position. They were ascribed by the sufferers to an antecedent attack of yaws."

Rat,[29] Daniels,[13] and Boissière reported cases with destruction of the nose and palate and discussed the probability of these lesions being due to yaws. Boissière also noted tibial involvement, joint swelling, and dactylitis.

Castellani[9] cites the sequelæ of two cases as follows:

"Case 1. Young Singhalese girl of about fourteen years of age. No history of syphilis either congenital or contracted: five years of age suffered, together with all other members of the family, from yaws and was treated in a Government Hospital from which she was discharged cured a few months later. She remained so till four months ago when she noticed a slight indolent swelling on the right leg which increased in size and finally broke out leaving a rather large ulceration. Two months later when I examined her, several ulcers were present in both legs, of irregular shape, thin margins, rather deep and without much secretion; the left tibia was arching forward; moreover on one of the ribs an indolent gummatous-like swelling was present. In the secretions of the ulcers no spirochætes were found. The girl has been treated with potassium iodide and the ulcers have healed, leaving large whitish irregular scars.

"Case 2. Singhalese girl about eleven years of age. Sister of the previous patient. No history of syphilis; genital organs intact. Five years ago she suffered from yaws at the same time as her sister. She recovered and remained in good health until three months ago when an ulcerative process developed on the soft palate which at the time I examined her, had already destroyed the uvula. The patient presented the thickening of the metacarpal bones and phalanges which had caused a certain distortion of the right hand. The potassium iodide treatment was begun two months ago, and the patient is rapidly improving, the ulcerative process of the palate being already arrested and healed. No spirochætes were found in the ulcer."

Ashburn and Craig[1] cite experiments produced by Neisser, Baermann, and Halberstädter[18] where three monkeys (*Macacus cynomolgus*) were inoculated subcutaneously with the bone marrow from a monkey (*Macacus cynomolgus*) infected with frambesia, with the result that one of the three inoculated with bone marrow developed the disease after an incubation period of forty-four days.

It is very evident that the majority of

bone and joint lesions of yaws is the result of a general infection. The explanation of the peculiar selective bone manifestations in some cases may be similar to that of the various manifestations of syphilis due to variations in strains.[15, 21, 22, 23, 31]. The experiments attempted by me to reproduce the bone lesions in animals have been been so far unsuccessful.

In the treatment of these cases the Castellani[5, 6] mixture was used according to directions, except that a small amount of glycerin was added to improve the taste and so get the patients to take the treatment consistently.

TABLE II.—*Castellani's mixture in the treatment of yaws*

	Quantity.
Tartar emetic.....grains.....	1
Sodium salicylate.....do.....	10
Potassium iodide.....drachm.....	1
Sodium bicarbonate.....grains.....	15
Water q. s.....ounce.....	1

Salvarsan was used in three of the cases, two of which received 0.4 gram, while the third received 0.2 gram, given intravenously.

In the observation of these cases, over a period of five months, the effect of the treatment on the regeneration of the bone at the sites of the bone lesions was studied by radiographs taken at monthly intervals as nearly as was practicable. In every case the clinical and subjective symptoms disappeared long before the radiographs showed the bone lesions to have disappeared.

The histories of the most important cases are as follows:

CASE I.—B. U., Filipino, eight years old. The primary lesion was on the right leg, while the patient was still a nursing baby. The secondary lesions appeared soon afterward and were most manifest on the hands and about the mouth. The secondary lesions gradually disappeared without treatment, but the mother yaw remained for over a year. Five years later the proximal phalanx of the index finger of the right hand became swollen and enlarged. Soon the adjacent fingers became similarly involved, but the patient stated that the fingers were not painful. On

PLATE I

FIG. 1. LESIONS IN PATELLA AND TIBIA. CASE 3.
FIG. 2. LESIONS IN OS CALCIS. CASE 2.

February 10, 1917, the roentgen ray pictures showed a total of nineteen bone lesions including those on the articular surfaces. The Castellani treatment was

given in one-half the adult dose, but the patient soon complained of gastric disturbance and headache. The amount was then reduced to one-fourth the adult dose. After five months the bone lesions showed definite improvement, and considerable regeneration of the bones had taken place.

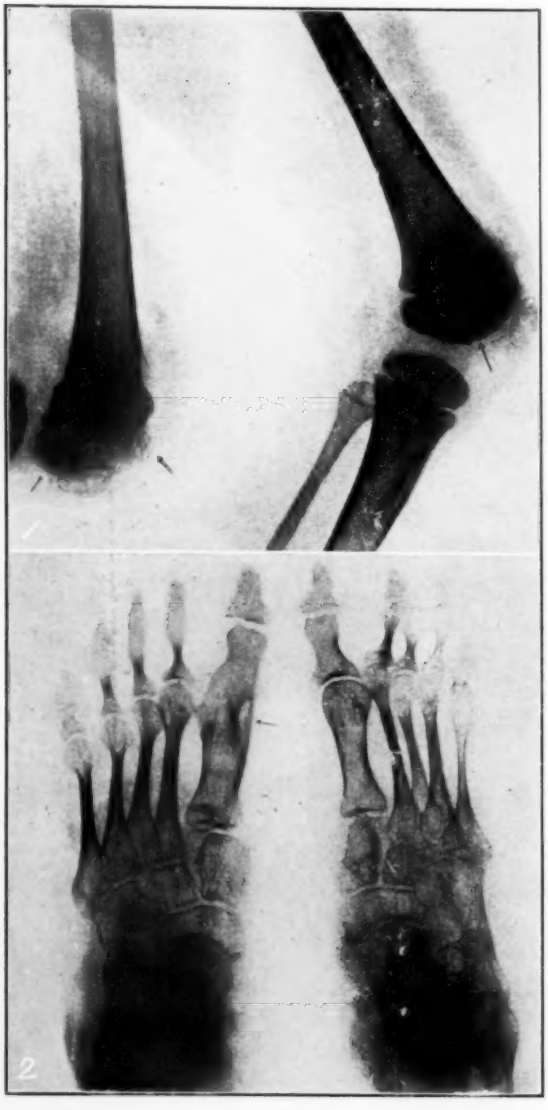

PLATE II

FIG. 1. JOINT LESIONS. CASE 1.
FIG. 2. ANKYLOSIS, FOLLOWING JOINT LESION. CASE 3.

CASE II.—M. S., Filipina, ten years old. The primary lesion was on the left leg in 1915. The secondary eruption, which appeared six weeks later, gradually disappeared after the third month without treatment. In August, 1916, she complained of pain in the left leg, which condition persisted until she was seen in February, 1917. The roentgen ray plates at this time showed one lesion in the lower part of the tibia and four in the os calcis. Further observation of this case was not possible.

CASE III.—P. G., Filipina, fifteen years old. The primary lesion appeared on the left leg in October, 1911. This lesion improved without treatment, but did not completely heal. The secondary eruption appeared three weeks later and was most marked upon the feet. Other lesions were scattered about the face, anus, and vulva. After one and one-half years the eruption had disappeared except from the lower extremities. It was elicited that severe rheumatoid pains involving all the joints developed about six months after the appearance of the primary lesion and persisted during the next four years. During this period of her illness the soft tissues of the middle finger of her left hand became contracted and the finger could not be extended, the external lesions had become large ulcers, and the bone and joints of both extremities were so painful that she suffered constantly. In 1915 she was admitted to a hospital in Manila in a helpless condition. During the two years she remained there the condition was but little relieved, and upon returning to her home she became entirely helpless from the pain she suffered. The ulcerations were deep and painful and emitted a foul odor of decomposition.

When the patient was seen in February, 1917, she weighed 22.68 kilograms (50 pounds) and was 1.1 meters (3.5 feet) in height. There were large areas of scar tissue and of ulceration involving the greater part of the lower extremities. She was badly emaciated and anæmic and cried continuously when she attempted to walk or move about. A roentgen ray survey of all the bones of her body was made and a total of 52 bone lesions, including those

on the articular surfaces, was found. She was given the Castellani treatment in full doses three times a day, one-half hour before meals. She continued to take the treatment regularly for the next two months, but still suffered from the bone and joint pains. The roentgen ray plates made at this time showed very slight improvement of the bone and joint lesions. She was then given 0.4 gram of salvarsan intravenously. The relief of the symptoms was as marvelous as in the cases cited by Strong in his work on cutaneous yaws,[33] in 1910, and the change in the bone and joint lesions became manifest radiographically within a month's time. No more salvarsan was given, but the Castellani treatment was continued until July 1, 1917, when the roentgen ray plates showed almost complete regeneration of the bone where the lesions had been. At first the lesions showed a lessened degree of translucency, then a diminution in size, and later a return of the cancellous-tissue appearance.

During the treatment she had persistent thirst, some salivation, and nasal catarrh, but no gastric disturbances.

CASE IV.—D. S., Filipino, seven years old. The primary lesion was on the neck, in June, 1915. One month later the mother yaw began to disappear, and a general secondary eruption followed after a short febrile period. As the secondary eruption disappeared, rheumatoid pains appeared in several of the joints.

When the case was first seen on February 10, 1917, the right arm was flexed at the elbow and made useless by a contracture on the anterior surface of the joint. This contracture had persisted for the past year. At this time the Castellani treatment was started in one-half the adult dose, and by the end of the second week the contracture had disappeared, but the painful bone lesions persisted for some time. Roentgenograms after full five months' treatment showed a marked improvement of the lesions, but regeneration was not complete. While taking the treatment, the patient vomited on several occasions, showed marked depression on the fifth day, became salivated, and had severe catarrhal symptoms.

PLATE III

FIG. 1. FLEXOR CONTRACTURE AND MULTIPLE BONE LESIONS. CASE 3.
FIG. 2. FIVE MONTHS LATER. CASE 3.

CASE V.—A. G., Filipino, twenty-six years old. The primary lesion appeared in August, 1914. This lesion persisted about one month. One month later the secondary eruption appeared about the axilla, elbows, mouth, anus, and prepuce, and these lesions disappeared without treatment, but soon afterward contractures of the extremities and severe rheumatoid pains in the feet developed. These conditions existed for about two years, and at the time I first saw him, he was able to get around and do light work. The roentgen ray plates showed bone lesions in the left os calcis, on the articular surface of the upper extremity of the left tibia, and on the

phalanges of the hands. The patient was started on the Castellani treatment February 10, 1917, and by February 25 marked improvement was evident. To hasten the recovery of the case, 0.2 gram of salvarsan was given intravenously, but the case did not return subsequently and could not be followed.

CASE VI.—A. S., Filipino, sixty years old. The primary lesion appeared on the right leg on June 5, 1915. Two months later he developed the secondary eruption and a varicose condition of the veins of the middle finger of the right hand. The finger became twice its normal size and was spindle-shaped, boggy, and worm-like to the touch, but was not painful. (It is questionable if this condition had any relation to the yaws.) He complained of pain in the tibia and femur, which had existed for one year at the time he was first seen on February 10, 1917. The roentgenograms showed a total of ten lesions. Those of the phalanges of the hands showed a marked narrowing of the cortex of the bones, while the one on the upper end of the tibia was on the surface of the bone and was excavated in character. He was given the Castellani treatment, which he took regularly, and although he stated that his pains had left him, the lesions were still evident by the roentgen ray after five months' treatment.

CASE VII.—C. R., Filipino, twenty-eight years old. The primary lesion was on the right knee in September, 1911. Two months later the secondary eruption appeared, after which there were violent rheumatoid pains in the phalanges on the feet and hands. One year after the initial lesion the distal phalanges were swollen and knoblike. On February 10, 1917, the roentgen ray showed rarefication of the terminal phalanges of the toes and thinning of the cortex of the phalanges of the hands. He was given the Castellani treatment, but he disliked the medicine, and the case could not be followed.

CASE VIII.—F. P. (As this case is one from which the description of the bone lesion has been made, a more detailed history will be given as prepared through the kindness of Doctor Domingo, senior house physician at the Philippine General Hospital.) General data: Filipina, twenty-seven years old. Married, housewife by occupation. Born in Parañaque, Rizal, and has lived there ever since. She came to the Philippine General Hospital during the latter part of January, 1917, complaining of pain in the bones and joints, although she also presented several sores on the face, scalp, and neck. Smokes five to seven cigarettes each day.

Family History.—No history of tuberculosis or syphilis. Father and mother liv-

PLATE IV. CASE 8.

FIG. 1. MOTHER LESION, BEFORE TREATMENT.
FIG. 2. MOTHER LESION, AFTER TREATMENT.
FIG. 3. SECONDARY ERUPTION, BEFORE TREATMENT.
FIG. 4. SECONDARY ERUPTION, AFTER TREATMENT.

ing and well. Has seven brothers, one of whom is in the United States, while the rest are in Parañaque. All are living and well, except one, who has the same external lesions as the patient.

Personal History.—The patient had her first menses at the age of thirteen and married when fifteen years of age. She has had four children, one of whom died of *suba** one has *bubas*† at present, and the other two are well. Has not had any miscarriages. Her husband is living and well and has no history of venereal disease. The youngest child is still nursing the mother.

Previous Illness.—None relevant to the present condition.

Present Complaint.—Primary lesion started in August, 1916, as a small papule on the anterior aspect of the left ankle. It was neither painful nor itchy. It continued to grow, and about January 16, 1917, when the case was seen with Doctor Guerrero at the Philippine General Hospital, the lesion was about 2 centimeters in diameter, in the form of a large round ulcer with more or less irregular edges and elevated granulating surface, from which an abundance of serum could be expressed. Examination of this serum showed twenty or more *Treponema pertenue* to every field. One cubic centimeter of this serum was taken from this lesion for inoculation of animals. In the latter part of October, 1916, the secondary eruption appeared on the face, scalp, neck, abdomen, and vulva. When the patient was admitted to the hospital, these lesions were nearly all circular in outline, although a few of the lesions on the face were more or less elliptical. They were raised from the surface and covered by a thick, hard yellowish crust. Removal of the crust left a raw, granulating surface. Some of the lesions of the face and abdomen were flattened out and deeply pigmented at the edges.

The pains in the bones and joints started in December, 1916, and gradually became more and more intense, until she could hardly walk. The phalangeal joints of the fingers were swollen and painful. No other joints were swollen, but pressure on the bones and other joints produced intense pain. There was no fever nor headache.

Roentgenograms of her hands were at this time made by Doctors Fernandez and Argüelles, and an abundance of lesions were present in all the bones. The Castellani treatment was given to her by Doctor Guerrero until she left the hospital. I saw the case again on February 25, 1917. The external lesions were healed, but she still

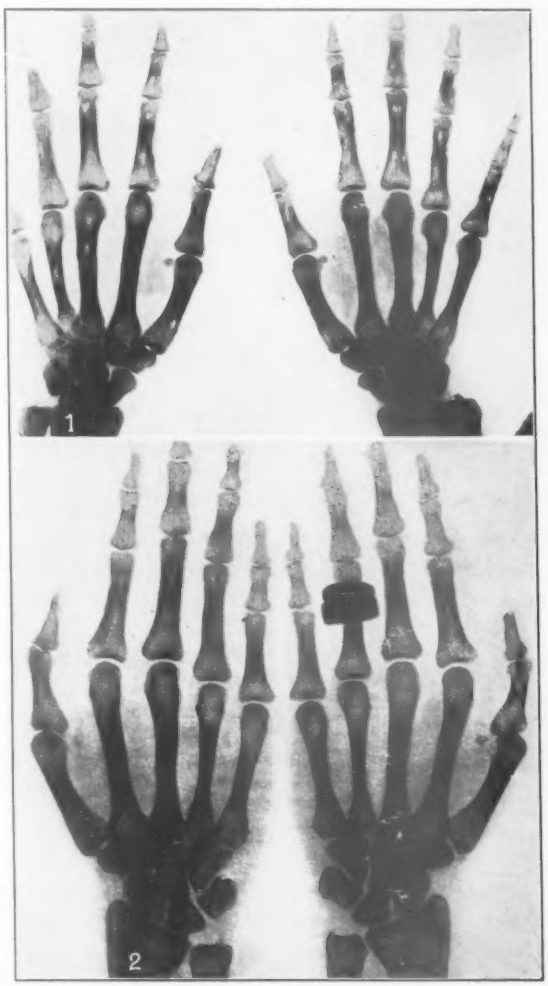

PLATE V.

FIG. 1. NO BONE REGENERATION AFTER SIX WEEKS OF CASTELLANI TREATMENT. CASE 8.
FIG. 2. REGENERATION OF BONE OF THE SAME CASE AFTER SALVARSAN. CASE 8.

*Infantile beriberi. †Yaws.

complained of pains in the bones. She had continued to take the Castellani treatment rather irregularly. She was induced to take her medicine as prescribed until March 2, when it was learned that she refused to continue with the treatment. Nevertheless she readily submitted to

PLATE VI.

FIG. 1. TYPICAL BONE LESIONS OF YAWS. CASE 8.
FIG. 2. REGENERATION OF BONES AT SITES OF LESIONS. CASE 8. SAME AS ABOVE.

treatment by salvarsan, and 0.4 gram was given intravenously on March 4. The roentgen ray plates taken on the same day showed no changes from those taken in February at the hospital. There was a total of 113 lesions. By the end of the second week, after this injection, the patient was entirely relieved of pain. In April the roentgen ray plate showed a very definite regeneration of the bone at the sites of the lesions. By the early part of July only a few places could be recognized where the lesions had existed.

CASE IX.—R. F., Filipino, sixteen years old. The primary lesion occurred on the right knee in September, 1911. The secondary eruption appeared one month later and gradually disappeared without treatment. He stated that in 1914 he suffered with pains in the joints involving the shoul-

PLATE VII.

FIG. 1. CHRONIC BONE AND JOINT LESIONS WITH DEFORMITY. CASE 1.
FIG. 2. CASE 1 FIVE MONTHS AFTER TREATMENT BY THE CASTELLANI MIXTURE.
FIG. 3. CHRONIC BONE LESIONS WITH DEFORMITY. CASE FROM DOCTORS FERNANDEZ AND ARGÜELLES.

ders, elbows, hips and knees, and the phalangeal joints of the fingers and toes. At the time he was seen, February 10, 1917, he was entirely well, except that his right heel was painful. The roentgen ray plates showed only one lesion in the os calcis. The case could not be followed.

CASE XXII.—R. C., Filipino, fifteen years old. The primary lesion was on the left knee in 1905. The secondary lesions appeared a few months later and persisted until 1913. No treatment was given. The secondary lesions gradually disappeared, but the mother yaw did not heal. From this time the bones and joints of the lower extremities became painful, and by August, 1916, he was unable to walk. He was in this helpless condition when I saw him on February 25, 1917. The roentgen ray plates showed a total of 18 lesions, involving the os calcis, scaphoid, tibia, fibula, and the articular surfaces of the tibia and femur on the right side and the os calcis, tibia, fibula, and the articular surfaces of the bones of the knee joint on the left side. After one month's treatment by the Castellani mixture he was able to walk with considerable ease. The case failed to come for further treatment and could not be followed.

Cases X, XI, XII, XX, XXI, XXIII, XXIV, XXV, XXX, and XXXI are of minor interest and are only referred to in Table I.

CONCLUSIONS

1. The majority of cases of yaws with bone and joint involvement shows characteristic roentgen ray lesions.

2. The radiograph can be used as an additional means of differentiating yaws from syphilis, when there is involvement of the bone, and as a confirmation of the evidence that the two diseases are distinct.

3. The pains complained of in the joints are due, in most part, to the presence of the lesions on the articular surfaces.

4. Twenty per cent of patients infected with yaws develop bone or joint lesions when not treated.

5. Regeneration of the bone is complete at the site of the lesion, if the destruction has not been too great.

6. The Castellani treatment causes a gradual disappearance of the bone and joint lesions.

7. Salvarsan is a specific in these cases, and rapid regeneration of bone follows its use.

I wish to express my appreciation to Doctors Crowell, Guerrero, Fernandez, Domingo, and Argüelles for their help and courtesies shown while doing this work, and to Mr. Hallare, who acted as interpreter and furnished most of the histories of the cases.

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PAIN IN THE LUMBOSACRAL REGION ASSOCIATED WITH CONGENITAL MALFORMATION OF THE TRANSVERSE PROCESSES OF THE FIFTH LUMBAR VERTEBRA*

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AMONG the patients sent to the roentgen ray department with a clinical diagnosis of strain, relaxation or arthritis of sacroiliac joints, or arthritis of hip, sciatica, lumbago or even possibly Pott's disease, we have noted the great preponderance of anomalies in the structure of the bones of the lumbosacral region, particularly of the transverse process of the fifth lumbar vertebra.

GROUP 1. The left transverse process is higher than normal and signs of a slight degree of arthritis are observed in the right sacro-iliac joint.

GROUP 2. Male, aged 35, complains of pain in the lumbosacral region for the past 10 months but cannot state definitely when or how it began, as there was no history of trauma or sudden onset. There is pain at all attempts of motion of the spine which radiates to the buttocks and thighs when standing or lying, but it is less pronounced in the latter position.

The radiogram shows the fifth lumbar vertebra low but not sacralized. Both fifth transverse processes are large and directed obliquely upward.

It has been mentioned by several authorities that the radiographs showing the lumbosacral region rarely presented an appearance that could be called perfectly normal. However, it is remarkable that in examining plates of that region which have been made for genito-urinary examinations or for some other non-orthopedic complaint, one finds a very much smaller percentage of anomalies in the structure or the situation of the bones.

Our examination of about sixty patients who came to the hospital complaining of pain in the lumbosacral region, has shown that only about 10 per cent did not present abnormalities. Of those, 60 per cent were slight or pronounced malformations of the transverse processes of the 5th lumbar vertebra; and we think

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that in nearly all these cases the pain, local or radiating, was caused directly or indirectly by this malformation. Owing to the wide difference in extent of these malformations, we can classify them in four different groups, each case presenting one or several characteristics of a particular group:

First Group.—One or both transverse processes are longer and larger than normal; they may apparently be in contact (constant, or in certain movements only) with the sacrum and iliac bones. Their shape sometimes suggests a change directly traceable to this contact; or the formation of a bursa at the point of contact is indicated.

Second Group.—One or both fifth lumbar transverse processes are very markedly long or large and seem to have taken an oblique upwards direction from this contact with the sacrum and iliac bones; the space between the lower border of the process and the upper border of the sacrum appears very narrow and sometimes it has entirely disappeared.

The two preceding groups are not so much true malformations of the transverse processes, as malposition of the bones of the pelvis; the sacrum is apparently situated very low between the iliac bones. This is more frequent in males than in females.

GROUP 3. Male, aged 30, who complains of pain over the left sacro-iliac region for the last 15 months. There is no pain in the hips or ischiatic regions. Marked rigidity of the lower lumbar spine with sharp pain and spasms of the muscles was produced upon all attempts of motion.

The radiogram shows the right transverse process probably touching the sacrum and ileum, but no sign of the formation of a calcified bursa. The tip of the left process is deflected upward.

GROUP 4. Man, aged 37, who for one year has complained of pain in the lower back and a dull pain in both hips but most marked in the left side. There is no history of trauma.

The radiogram shows sacralization of the transverse processes of the fifth lumbar. The left process has developed into a large wing which articulates with the left part of the sacrum by joint. This shows signs of arthritis. The right transverse process is less developed but it articulates with the ilium and sacrum.

In plates that can be considered as showing a normal shadow, the upper surfaces of the fifth transverse processes are about on, or slightly below, the upper border of the crest of the iliac bone, this position showing little change in different plates taken at a higher or lower angle. There must be at least an apparent distance of three-fourths of an inch between the lower borders of the

processes and the upper surfaces of the sacrum, and between the ends of the processes and the borders of the iliac bones, respectively.

Third Group.—This group is represented by the very marked enlargement outwards and downwards of the fifth lumbar transverse processes which present a size two or three times that of the process on the opposite side, its shadow overlapping the shadow of the upper part of the iliac bone and sacrum, with sometimes the presence of a bursa, but no actual joint formation.

GROUP 4. Unilateral. Girl, aged 21, treated for scoliosis five years ago for which she wore a plaster cast. At the time of admission she had complained of pain in the sacral region for several weeks which was more marked on the right side but it radiated to both hips.

The radiogram shows a very large right fifth lumbar transverse process which is articulated to the sacrum by a true joint. In these joints I find signs of arthritis. The space between the lateral process and the sacrum seems to be reduced. Slight degrees of arthritis are also demonstrable in both sacro iliac joints, slightly more pronounced in the left.

Fourth Group.—This group would include the malformation of one or both fifth lumbar transverse processes which are considerably larger than normal and united with the upper part of the sacrum by a true joint. In fifty plates showing malformations of the fifth lumbar transverse processes, we have found thirteen that may be classified in this fourth group. The malformation was unilateral in eight cases, bilateral in four cases.

In all cases the vertebra bearing the malformed transverse process or processes is a *true* fifth lumbar, the sacrum showing the regular number of segments and the transverse process of the vertebra above presenting the characteristic aspect of the fourth lumbar.

The histories of the patients bearing one or several of these four groups of anomalies are remarkably alike. About two-thirds of them are male patients. They came to the Hospital complaining of pain of a duration extending from a few days to several years; the period of their life when the pain is stated to have begun is rarely before their twenty-fifth year. Very few of them mention or recall a trauma or jerk preceding or starting the pain, and when there

GROUP 4. Bilateral. A woman aged 32 years who complains of pain of two weeks' duration in the lumbosacral region. Only slight pain is elicited by pressure over the sacro-iliac articulations. There is also slight limitation of all movements. Hyper-extention of the lumbar spine causes pain radiating to the hips.

The radiogram shows sacralization of both fifth lumbar transverse processes by true joints. Signs of a slight degree of arthritis can be seen at the lower border of the left sacro-iliac joint.

has been an accident, they often recall that they had felt some pain prior to it.

The clinical examination usually shows tenderness by pressure over the region of one or both sacro-iliac joints, limitation of motion of the lumbar spine with spasm and pain, the sharpest pain being encountered in movements of extension or hyperextension. There is often rigidity of the spine up to the middle dorsal region.

The patients also very often complain, even in repose, of pain in the lumbar and ischiatic regions, in the hip joints and different groups of muscles in the thighs and legs.

The clinical symptoms explain why sometimes these patients have been referred for roentgen ray examination with a temporary diagnosis of Pott's disease.

The examination of the radiographs of these patients seems to give, in almost all the cases, an explanation of the symptoms found at the clinical examination.

We may consider the pain as being produced either:

(1) By compression of soft tissues, muscular or fibrous (ligaments) between the bony parts.

(2) By irritation and arthritis of normal or abnormally formed bursæ and joints.

(3) By the slow acting strain on ligaments when a very slight relaxation of the joints of this region is produced (these joints normally allowing only extremely limited movements).

(4) By pressure or tension due to the persistent malposition of the bones on different segments of the trunks of the nerves which emerge from the lateral foramen of the fifth lumbar vertebra, especially of the lumbosacral cord.

The presence of these anomalies also facilitates the production of slight traumatic displacements which leave behind them sprains; it also facilitates the anterior displacement of the fifth lumbar vertebra or spondylolisthesis, and is sometimes the primary cause of scoliosis.

The fact that the ossification and union of the segments of the sacrum are not complete before the twenty-fifth year, often later (the upper segment being the last one to be completely ossified) explains why these patients rarely suffer before this age.

In fact, until the ossification is nearly completed, real contact between a large fifth transverse process and the sacrum or ilium is not produced or the tissues which come in contact are not hard, and yield easily to pressure. The abnormal joint or bursa therefore is not formed. With the completion of ossification, if the pressure of the enlarged process is made on the sacrum, there may be a tendency to lateral tilting of the fifth lumbar and, in the upright position, a tendency to compensatory opposite tilting of the sacrum, which causes strain on both sacro-iliac joints and subsequent arthritis, this arthritis being generally more marked on the side opposite to the malformation.

If the pressure of the process is made on the iliac bone, it causes a direct strain, a stretching of the ligaments of the sacro-iliac joint at the same side with subsequent arthritis on both sides. Arthritis is also generally more marked at the side opposite to the malformation.

It has often been doubted whether this kind of malformation was able to cause pain by direct pressure on nerves or by tension due to persistent malposition. When the malformation is unilateral the patient generally complains of pain over the region of both sacro-iliac joints, the pain often being more severe on pressure of the joint opposite the malformation. On the other hand, the pain radiated to the hip, buttock, ischiatic region, also to the thigh and leg, is generally felt on the same side as the malformation. If we consider now that the anterior ramus of the fifth lumbar nerve runs over the upper part of the sacrum, we may suppose that the narrowing and, even in certain cases, the apparent suppression by an enlarged fifth lumbar transverse process of the space between the transverse process and the sacrum, may cause a certain amount of

compression of the nerve, or tension by lengthening its way downward.

This nerve springs from the lumbosacral cord and contributes to the sacral plexus. A pressure or tension on any part of it may be an explanation of the pain radiating to the hip, buttock, thigh and leg. And for the same reason that the development of the upper part of the sacrum is not complete before the twenty-sixth or thirtieth year, the pressure or tension is not made until full development is nearly reached, the pain having appeared insidiously; and this explains why most of these patients recall only with difficulty the time when they began to suffer.

How this malformation can facilitate spondylolisthesis, which gives, for about the same reasons, pains analogous to that above mentioned, is shown by the examination of the skeleton; the upper part of the sacrum (ala) at either side of its articular surface consists of two planes oblique anteriorly and downwards; if then a movable part, as a very large fifth lumbar transverse process, makes a downward pressure on these sacral planes, it will obviously take an anterior downward direction, thus facilitating the forward displacement of the fifth lumbar, especially if there is already a predisposing affection of the vertebra, as a defective ossification of its foramen, or spondylolisthesis.

That the malformation of a fifth lumbar transverse process may be the primary cause of scoliosis has often been described by authorities.

In the examination of fifty scoliosis patients, six showed a marked difference in the size of the transverse process of the fifth lumbar, this being associated with or without the presence of hemivertebræ, or a supernumerary vertebra.

But in several patients the lower lumbar vertebræ were rotated to such a degree as to render impossible a clear view of the fifth lumbar transverse processes.

When scoliosis is due to a marked inequality in the size of the fifth lumbar transverse process, the primary curvature has its convexity opposite to the side of the larger process, the secondary curvature being dorsal, always very much more pronounced, with convexity on the same side as the large process. The primary lumbar curvature often disappears before any corrective treatment has been undertaken. It is to be noted that in the cases where there are only four lumbar vertebræ, without anomalies of the upper part of the sacrum, the lateral processes of the last lumbar vertebra present the characteristics of the fourth lumbar transverse processes.

Upon reexamining the patients whose plates of the sacral region (without showing the whole lumbar spine) did not seem to show anything abnormal, but where the transverse processes of the last lumbar vertebræ presented the characteristics of the fourth lumbar processes, we have found in all only four lumbar vertebræ. In these cases the sacrum shows always six or seven foraminæ instead of four or five as normal, the fifth lumbar contributing in its entirety to the formation of the sacrum. The pain of the patient bearing this abnormality was almost always found to be due to some other cause than an orthopedic affection.

The malformations of the fifth and sometimes of the fourth lumbar transverse processes thus prove to be an incomplete attempt of the fourth and fifth lumbar vertebræ to participate in the formation of the sacrum, the non-completion of this attempt creating the condition which causes pain.

When six lumbar vertebræ are found, the sacrum does not show a smaller number of lateral foraminæ. These cases of six lumbar vertebræ are very rare, compared with those of four, the ratio being about one to ten.

The great number of these complete or incomplete attempts at participation of the fourth and fifth lumbar vertebræ in the formation of the sacrum seem to support the theory advanced by some anatomists and orthopedic surgeons that the number of joints of the spine is too great for the actual "modus vivendi" of man, and that,

through the slow evolution which tends to suppress organs that are used little or not at all, the pelvic girdle is coming nearer to the scapular girdle, the lower lumbar region being subjected in actual life to very few movements of limited extent.

These malformations of the fourth and fifth lumbar vertebræ do not therefore seem to belong to the same class of congenital malformations found in the other parts of the spine; such as defective or supernumerary vertebræ, hemi- or entire (which are accidents in the metamerism of the embryo), but are a more or less perfected phase of the evolution of the human skeleton.

Before closing this discussion, we must add that the roentgenological conclusions about the position of the bones of the lumbosacral region can rarely be arrived at without making several plates taken from different angles, above and below the level of the upper border of the sacrum. The stereoscope does not seem to help a great deal in this investigation. The lateral view is not of great value as far as the examination of the fifth lumbar transverse processes is concerned, but is of first importance, when obtainable, to appreciate the extent of spondylolisthesis or the degree of the backward tilting of the sacrum.

THE VALUE OF RADIUM IN CURING DISEASE, IN PROLONGING LIFE, AND IN ALLEVIATING DISTRESSING SYMPTOMS*

BY W. H. B. AIKINS, M.D.

TORONTO

DURING the comparatively short time which has elapsed since radium was first introduced into therapeutics, the treatment has passed through many phases, but it is now being established upon a firm and scientific basis, and is slowly, but surely, enormously extending its field of usefulness. A few brilliant successes in its early days caused it to be hailed by overenthusiastic advocates as an almost universal panacea, while on the other hand a certain number of failures resulted in its unconditional condemnation by some of the more conservative members of the profession, who are invariably inclined to be sceptical in regard to the merits of any new remedy. Further investigation and more extensive experience, however, have shown that for many of these failures radium itself was not to blame, but a defective knowledge of its exact characteristics, dosage and method of application, and in some instances an injudicious selection of cases for the treatment, which, in common with every other method, has its limitations. The absolute necessity of recognizing these, and giving them due consideration, before expressing a definite opinion as to the value or otherwise of radium treatment, will be obvious. Meanwhile, though the value of new remedies can only be accurately determined by prolonged experience and observation, it is advisable to approach the subject with an open and unbiased mind, and not hesitate to avail ourselves of any means which offers of removing or alleviating the terrible suffering caused by the diseases with which humanity is liable to be affected. Everyone will agree that cancer is one of the most important of these diseases.

A want of knowledge as to the proper dosage has been responsible for failure in not a few cases, either too much or too little radium being given. The use of too small an amount of radium may account

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for failure, as an inadequate dose is said to have the effect of stimulating a malignant growth instead of attaining the desired object of inhibiting it.

While it is now generally recognized that radium is dependent for much of its efficiency upon the fact that in cancer it exerts a selective destructive influence upon the cells of the new growth, there is no doubt whatever that it also affects normal tissue destructively to a certain extent; and caution is therefore necessary lest, while we increase the dose in the hope of increasing its power to destroy the cancer cells, we do so to such an extent that it has a disastrous effect on the normal tissue. When a lesion is deeply situated, increased dosage will to a certain extent compensate for its increased depth; but such an increase is necessarily limited by the necessity of stopping short of such a dose as will entail the risk of serious injury to the normal tissue. This makes it imperative that the principles of dosage should be definitely established, and its limitations and variations in individual cases thoroughly understood. The investigations which have been carried out in recent years have added much to our knowledge in this respect, have reduced the risks, and thus greatly extended the field of usefulness of radium therapy.

Darier and others are of opinion that another factor which has sometimes led to the discredit of radium treatment, is that in dealing with cancer of the skin the absolute necessity of making an accurate diagnosis of the particular variety of cancer present before proceeding to treat it with radium has not been sufficiently recognized. This is of importance, in view of the fact that all the varieties of cancer which affect the skin do not respond equally well to radium. This applies especially to the squamous and spino-celled epithelioma, which tends to rapid involvement of the ganglia and metastasis, and usually leads to a fatal result in less than two years. Melanotic sarcoma originating in nevi is also not so amenable to radium.

Malignant disease, the etiology of which still remains more or less of a mystery, holds a prominent position among the morbid conditions for which we have for many years past been anxiously seeking a remedy, and was one of the first, and is still one of the chief conditions for which radium is employed. In the early days its use was largely restricted to the superficial forms, but its beneficial effects gradually led to its use in more deeply situated cancerous growths, such as cancer of the uterus and other internal organs. The cases of this kind which were at first submitted to radium were, as a rule, those in very advanced stages of malignancy, in which surgery and all other measures had failed, and radium was applied only as a last resource when the patients were in a desperate condition. Under these circumstances it was obviously unfair to blame the remedy for its failure to bring about a cure, but in spite of this cases have been reported from time to time in which the local manifestations have disappeared and the life of the patient has been prolonged.

After the many vicissitudes through which radium therapy has passed since its first introduction into therapeutics, it may be said to occupy at the present time a firmly established position, and in some conditions, notably cancer of the face, it may be regarded as preeminently the treatment of election, as it can be relied upon to bring about a complete and permanent cure in a very large proportion of cases, without leaving the disfiguring and contracted scars which so often result from surgery, and which so frequently are the site of recurrence of the trouble. In the treatment of such cases there is none other which can compare with radium in the excellence of its cosmetic results. A further recommendation of radium in this connection is the ease and painlessness with which it can be applied.

The treatment of more deeply situated cancer has been attended with varying results, sometimes in desperate and in-

operable cases with the most unexpected success. While there is no doubt that a sufficiently extensive surgical operation, provided it is possible to remove all the cancer cells present, gives a fair prospect of recovery and freedom from recurrence, if the disease is allowed to progress it reaches a stage when surgical removal is impossible. In these advanced cases, which are hopeless from the point of view of surgery, radium has shown itself to be invaluable, and it now appears to be definitely established that it exerts a reliable influence upon many forms of malignant growth.

As regards the effects of radium upon the cancer cells, in a recent editorial in the *Lancet* the process is described as follows: "The cells become granular and break up, and sometimes vacuoles appear until absorption of the débris occurs, and after a time a shrunken cell membrane is all that remains of the formerly malignant cells. Then there appears new fibrous tissue, the amount varying in different cases, and thus, if a successful result is obtained, the malignant growth is replaced by a fibrous nodule, while in some cases the cure is so complete that no trace whatever is left of the malignant disease." This destructive influence is exerted on forms of living tissue, but is decidedly greater on the pathological cells than on the healthy tissue.

THE VALUE OF RADIUM IN CURING DISEASE

Among the most brilliant results which have been obtained from radium from this point of view are those in cancer of the skin and mucous membranes. This applies especially to basal-celled epithelioma and rodent ulcer. Other types of epithelioma are more refractory, most notably the squamous-celled variety, those accompanied by peripheral lymphangitis, and those recurrent in a cicatrix. Owing to this it was believed a few years ago that such forms of cancer were incurable by radium, but it is now generally recognized that the reason for failure was insufficient dosage. The squamous-celled variety of epithelioma required three or four times as much radiation as the basal-celled variety in order completely to eradicate the disease and thus make recurrence improbable.

One great advantage of radium over surgery is that it leaves supple skin, with very little scar formation, whereas after operation there is a contracted scar, which is frequently the site of recurrence, owing to the irritation to which it is constantly subjected. I have frequently noted a reappearance of the disease at the site of stitches. The value of this will be appreciated when we remember that one of the facts definitely established in regard to cancer is that irritation is an important factor in its etiology.

Radium has also a wide field of use in the disease of the skin and mucous membrane other than malignancy,—so much so that its employment by modern dermatologists is almost imperative. Benign tumor growths, such as moles, warts, papillomata, are removed by it, while in the treatment of disfiguring birthmarks, either port-wine stains or angiomata, it is the method of election, as its application is easy and painless and its cosmetic results are not attained by any other method.

In keloid, lupus, erythematous, tuberculosis of the skin in its various aspects, it is of the greatest value. Leucoplakia of the buccal mucosa or tongue, which is often the forerunner of malignancy, responds favorably to radium therapy.

A recent report of the London Radium Institute states that experience there tends to show that rodent ulcer can be cured with certainty by the application of radium, and, provided a sufficient dose is given, does not recur.

In the treatment of cancer of the lip, both in early and advanced cases, results are equal or superior to those of surgery, more than 90 per cent of the early cases being permanently cured without residual deformity, and also a fair proportion of the advanced cases. When we compare the

90 per cent of cures without recurrence with the results of surgery in this condition, the superiority of the radium treatment is obvious. The literature of the subject shows that radical operation at an early stage, when there is no obvious affection of the glands, is followed by recurrence in more than 50 per cent of the cases, and if the glands are involved at the time of operation, in more than 90 per cent.

The value of radium in treating sarcomatous tumors of the skin, and some more deeply seated, is well established.

Another condition in which the success of radium has been so remarkable that it has come to be regarded as the method of election, is that of fibroids of the uterus. In uncomplicated cases, however severe, experience indicates that it can be relied upon to arrest hemorrhage and discharge, bringing about amenorrhea, and it will also cause shrinking or complete disappearance of the tumor.

Cases treated as long ago as 1905, when radium therapy was in the experimental stage, have remained well; and in many large gynecological clinics the use of radium has almost superseded operation in fibroids and certain forms of uterine hemorrhage. The only exceptions made are in cases in which the diagnosis is doubtful, in those in which the fibroids are suppurating, and in those in which symptoms of pressure render operation imperative. An advantage of radium in these cases as compared with the roentgen rays, which are also successful in arresting hemorrhage and bringing about amenorrhea, is that radium can be brought into direct contact with the diseased uterus, while the influence of roentgen rays depends largely upon their action upon the ovaries. In the presence of sub-mucous fibroids, associated with endometritis, radium arrests the hemorrhage by a primary action upon the endometrium and a secondary effect upon the ovaries, but with the roentgen rays the reverse takes place, and as a result the symptoms of the menopause due to radium are much less than those due to the action of the roentgen rays. In cases which are inoperable, owing to the severity of the hemorrhage, radium will often arrest the hemorrhage and thus render the condition operative.

As regards cancer of the uterus, the mortality after surgery has been very great, even with the best technique and in the hands of the most skilful surgeons. The general opinion is that operation should be performed in every operable case, but that the use of radium after operation will tend to prevent recurrence, and thus increase the percentage of cures. In some instances the use of radium in an inoperable case will render a radical operation possible. A very large proportion of these cases are already inoperable when they first come under the observation of the surgeon.

In the therapy of Grave's disease or exophthalmic goiter, a judicious use of the radium rays will in many cases produce results which are nothing less than brilliant, combined of course with the usual medical measures of rest, diet, medication, etc. Radium applied over the thyroid slows the rapid pulse, lessens the nervous excitement, causes a variable degree of shrinkage of the gland and in numerous cases has rendered quite unnecessary the surgical operation which has been proposed as a last resort of treatment.

THE VALUE OF RADIUM IN PROLONGING LIFE

Those who express unfavorable opinions as to the value of radium therapy frequently do not consider sufficiently the fact that a very large number of the cases submitted to its treatment are in the last stages of cancer, when the growth is so extensive that surgery is powerless, and the patient is so ill that the fatal termination of the disease is imminent. In these cases radium is only used as a last resource, and it has frequently done what no other known form of treatment is capable of doing. In cases of inoperable cancer in the uterus and other regions, radium often causes

disappearance of the local manifestations, and in certain cases cure has been affected in an apparently hopeless case. Life may thereby be prolonged for months or even years, although the patient may succumb subsequently to metastasis in other parts of the body.

Postoperative radiation is now regarded as a most important part of radium therapeutics. Many cases of cancer of various forms have been reported, in which the patient has remained without recurrence for three or four years or more after the radium treatment, sometimes for such a prolonged period that cure may be assumed. In other cases the growth may become so much reduced in size that a previously inoperable case may become operable. In the Report of the London Radium Institute, issued at the end of 1918, it is stated that between 1911 and 1914 a large number of cases were operated upon by surgeons of high standing and the operations were so extensive that, in the opinion of the operators, recurrence was inevitable. After postoperative treatment with radium, recurrence took place in less than 20 per cent of the cases, a result which is believed to be unequalled in the records of selected cases operated upon by surgeons of extensive experience.

When radium is applied over the enlarged spleen, it has a favorable influence in myelogenous leukemia. It is a well-known fact that this is one of the most hopeless conditions in the whole domain of medicine, and the literature of the subject indicates that practically all cases terminate fatally, the acute in a few months, the chronic in from two to four years. Ordway, Peabody, Griffin and Clarkson have recently discussed the treatment of this condition by the application of radium. The reduction of the white count is most remarkable, especially in the acute cases, and the size of the spleen is greatly decreased. Many of the patients have been able to return to their occupations for a time at least. These writers consider that radium is the best remedy we have at present. Should splenectomy be considered necessary, Griffin has shown that the operative mortality would be considerably reduced if operation could be performed at a time when the spleen was comparatively small, freely movable, and the general condition good. The first splenectomy for myelogenous leukemia was reported by Bryant in 1866, the patient dying about two hours later. From this time up to 1915, 51 cases were reported with an operative mortality of 86 per cent. Mayo and Balfour have reported their results in 18 cases which were treated by preoperative radium at the Mayo clinic. The spleen was much reduced in size, the operation easily performed, and the only postoperative complication was a case of peritonitis. Eight of the cases remained alive from nine months to three years after the treatment.

It has been demonstrated experimentally that the blood, spleen, bone marrow and lymph nodes are normally the most sensitive organs in the body to the action of radium and the *x*-rays. A few hours after irradiation there is a destruction of the cells of the lymphoid tissue and spleen and there is also a disappearance of cells in the bone marrow. In the bone marrow the cells most easily affected are the lymphocytes and non-glandular myelocytes. This destructive effect is much more marked in the leukemic than in the normal animal, and in some cases after six weeks' treatment, the white count has fallen from 1,250,000 to 8,000. In view of these results the possibility is suggested that if treatment could be begun at a sufficiently early stage, and continued long enough, the spleen, bone marrow and lymphatics might be influenced so favorably that the excessive production of immature forms of leucocytes might be definitely and permanently inhibited.

Even in cases in which the general condition is extremely bad, the radium treatment may be followed by marked improvement and increase in strength and weight, and there may be remissions of longer or shorter duration. Though death will ultimately supervene, there is no question

that the treatment may prolong life for a number of years. It remains a question whether cure will ultimately be obtained by means of improved technique or by treatment at an earlier stage, but it must be conceded that results already obtained are sufficiently remarkable. In Hodgkin's disease also there is marked general improvement and reduction in the size of the affected lymphatics; but in order to obtain this result it is necessary to persevere with the treatment.

THE VALUE OF RADIUM IN ALLEVIATING DISTRESSING SYMPTOMS

While I do not wish to minimize the curative value of radium, or its value in the prolongation of life, it must be admitted that in many cases the prolongation of life alone would be a doubtful blessing, owing to the distressing symptoms which render life a burden, not only to the patient himself, but often to those around him. In this direction radium has conferred one of the greatest benefits upon humanity. Radium has frequently been proved superior to every other known form of treatment, in that it has been able to control successfully the unpleasant symptoms associated with the last stages of malignant diseases in cases where recovery is apparently hopeless. Thus it renders the last weeks or months of the patient's life tolerable and comparatively comfortable. In not a few of these desperate cases the local symptoms have completely disappeared, or the growth has diminished to such an extent that operation can be performed with a fair prospect of success.

All authorities are agreed that in many very advanced cases of cancer of the uterus, radium relieves the pain, reduces the discharge and hemorrhage, and causes the disappearance of the unpleasant odor which is such a trial to the patient and her friends. In addition to this, unexpected apparent cures have been reported in some of these cases, and in those not ultimately cured there is marked relief of the symptoms.

During the war radium was used extensively in the treatment of wounds. It has been found most useful in dealing with vicious cicatrices of various kinds, when they are associated with painful symptoms due to inclusion of nerve fibers or trunks, or when they interfere with the mobility of joints. In such cases the application of radium has frequently led to the restoration of normal mobility, to loosening of tendinous and muscular adhesions and also to resumption of the function of compressed nerves. It has also given great relief in cutaneous manifestations, which have been observed so often in connection with war wounds and which are very refractory to ordinary methods of treatment. These are most frequently due to the excessive use of strong antiseptics, such as tincture of iodine, and have as a rule responded well to radium therapy. Degrais and Bellot report a series of excellent results in functional impairment following war wounds. They state that in vicious cicatrices radium acts in four ways: first, it transforms the cicatricial tissue into supple connective tissue; second, it dissolves and levels keloid tissue; third, it detaches the cicatrix from adherent deep tissues; and lastly, it liberates compressed nerve fibres, causing disappearance or amelioration of motor or sensory troubles.

There is no doubt that the present position of radium therapy is very encouraging, and such as to give rise to great hopes for the future. There is no question as to its value as an adjunct to surgery, both before and after operation, and the results of prolonged experience leave no excuse for ignoring its usefulness in this connection. But perhaps the greatest benefit it has conferred upon humanity consists in the relief it has afforded to countless patients whose condition is absolutely hopeless from the point of view of cure. Even if it had never succeeded in curing a single case, radium has amply justified itself by its palliative properties.

LEGAL RIGHTS OF THE ROENTGENOLOGIST AS A WITNESS

BY JOSEPH FRIEDMANN, M.D.

NEW YORK CITY

ONE of the evils which the roentgenologist has to contend with is the subpœna duces tecum, which calls him into court with plates in his possession, to testify when the case reaches trial months and months after the examination was made. This often works hardship to the roentgenologist if it is not thoroughly specified before, what compensation he shall receive. But in the eyes of the law, the fact should not be forgotten that he need not testify unless it is agreed that he is to receive compensation as an expert, and he may take this stand before the presiding Justice after the question is asked, "Are you an expert roentgenologist?" If the answer is "Yes," and he qualifies as such, then he need answer no questions unless compensated as an expert. This, if clearly held in mind, will save many embarrassing situations, loss of time, etc.

The above statement was made at the mid-winter meeting of the American Roentgenologists, held at Atlantic City, January 24, 1919. At the request of some of the audience I made a more careful search into the matter from a legal standpoint.

A study of the subject of expert testimony in general, was carefully compiled from the reports of the District of Columbia, the states of Iowa, Maine, Massachusetts, Minnesota, North Carolina, Indiana, Arkansas, Colorado, Georgia, Illinois, Missouri, Nebraska, New Jersey, Pennsylvania, Texas, Wisconsin, Louisiana and New York, and also a number of court records and reports of the Canadian provinces.

In a number of the states, the statute distinctly provides for an allowance in addition to the ordinary fee to expert witnesses who testify as to matter of opinion; and a number of authorities have gone so far as to hold that an expert witness may refuse to testify until his extra compensation is paid or secured, and is not guilty of contempt in so doing.

Apart from the statute, a written opinion presented to me by a member of the bar claims that an expert witness may be compelled to testify as to matters of professional opinion, of matters of which he has gained a special knowledge by reason of his professional training or experience, without any compensation other than the fee of an ordinary witness, and his refusal to testify unless paid an extra compensation may be punished as contempt.

He further states: "And *a fortiori* a professional man who attends as an ordinary witness as to facts which have come within his observation, rather than as an expert in any matter relating to his profession, is entitled to only the ordinary witness' fees. Where, however, it is desired to have an expert witness give testimony of a nature which requires special preparation, investigation, research or examination of any kind by him, in order to prepare himself to testify, he has a right to regard such preparatory work as a professional service, and cannot be compelled to perform the same without the payment of a professional fee." This seems clearly to establish that the roentgenologist, who must prepare himself by special technique and skill in exposing and developing his plates, and in their interpretation in addition to his special training in the care and conduct of his apparatus, including tubes, coils, converters, transformers, etc., is a highly specialized expert, and that there need be no quibbling in the minds of the learned jurists before whom he may appear as to his being such, particularly as each case in itself must subsequently

be studied very carefully before a professional opinion can be promulgated with reasonable certainty as to the ultimate outcome of a case.

The following shows a complete and thorough résumé of all the opinions in the different courts up to date, and any subsequent opinions which may have been rendered by different legal tribunals are of cases which have been pending and in which the decisions were subsequently rendered.

COMPENSATION OF EXPERTS

In some jurisdictions the statutes provide for the allowance to expert witnesses, who testify to matters of opinion, of an extra compensation in addition to the ordinary witness fee:

District of Columbia.—U. S. v. Cooper, 21 D. C. 491.
Iowa.—Keller v. Harrison, 151 Iowa 320, 128 N. W. 851, 131 N. W. 53; Snyder v. Iowa City, 40 Iowa 646.
Maine.—Gordon v. Conley, 107 Me. 286, 76 Atl. 365.
Massachusetts.—In re Clark, 104 Mass. 537.
Minnesota.—Farmer v. Stillwater Water Co., 86 Minn. 59, 90 N. W. 10 (where hydraulic engineers were allowed twenty and twenty-five dollars per day); State v. Teipner, 36 Minn. 535, 32 N. W. 678.
North Carolina.—State v. Dollar, 66 N. C. 626.
See 50 Cent. Dig. tit. "Witnesses," Section 65.

and some authorities have gone so far as to hold that an expert witness may refuse to testify until his extra compensation is paid or secured:

Turnbull v. North British R. Co., 5 Sc. Sess. Cas. (5th ser.) 944; Marquis v. Robidoux, 3 Quebec Pr. 433; Guinea V. Campbell, 22 Quebec Super. Ct. 262.
If the witness voluntarily testifies without insisting upon compensation as a condition of giving his testimony, he cannot recover from the person in whose behalf he testifies more than the statutory witness' fee. Tiffany v. Kellogg Iron Works, 59 Misc. (N. Y.) 113, 109 N. Y. Suppl. 754.

and is not guilty of contempt in so doing.

Buchman v. State, 59 Ind. I, 26 Am. Rep. 75 (followed in Dills v. State, 59 Ind. 15); U. S. v. Howe, 26 Fed. Cas. No. 15, 404a. But compare Gaston v. Marion County, 3 Ind. 497.

But the more general rule is that, apart from statute, an expert witness may be compelled to testify as to matters of a professional opinion, or matters as to which he has gained a special knowledge by reason of his professional training or experience, without any compensation other than the fee of an ordinary witness:

Arkansas.—Flinn v. Prairie County, 60 Ark. 204, 29 S. W. 459, 46 Am. St. Rep. 168, 27 L. R. A. 669 and note (followed in Clark County v. Kerstan, 60 Ark. 508, 30 S. W. 1046).
Colorado.—Larimer County v. Lee, 3 Colo. App. 177, 32 Pac. 841.
Georgia.—Schofield v. Little, 2 Ga. App. 286, 58 S. E. 666.
Illinois.—Wright v. People, 112 Ill. 540.
Massachusetts.—Barrus v. Phaneuf, 166 Mass. 123, 44 N. E. 141, 32 L. R. A. 619.
Minnesota.—State v. Teipner, 36 Minn. 535, 32 N. W. 678.
Missouri.—State v. Bell, 212 Mo. 111, 111 S. W. 24; Burnett v. Freeman, 134 Mo. App. 709, 115 S. W. 488; Burnett v. Freeman, 125 Mo. App. 683, 103 S. W. 121.
Nebraska.—Main v. Sherman County, 74 Nebr. 155, 103 N. W. 1038.
New Jersey.—See Fonda v. Bolton, 6 N. J. L. J. 240.
Pennsylvania.—Com. v. Higgins, 5 Kulp 269. See also Ramschasel's Estate, 24 Pa. Super. Ct. 262.
Texas.—Summers v. State, 5 Tex. App. 365, 32 Am. Rep. 573.
Wisconsin.—Philler v. Waukesha County, 139 Wis. 211, 120 N. W. 829, 131 Am. St. Rep. 1055, 25 L. R. A. N. S. 1040 and note, 17 Ann. Cas. 712 and note.
Canada.—Butler v. Toronto Mutoscope Co., 11 Ont. L. Rep. 12, 6 Ont. Wkly. Rep. 527, 5 Ann. Cas. 992 and note.
See 50 Cent. Dig. tit. "Witnesses," Section 65.

Witness cannot recover additional compensation on a quantum meruit. Chicago, etc., Electric R. Co. v. Judge, 135 Ill. App. 377.

Extra compensation may be recovered on express promise. Barrus v. Phaneuf, 166 Mass. 123, 44 N. E. 141, 32 L. R. A. 619; Dixon v. People, 168 Ill. 179, 48 N. E. 108, 39 L. R. A. 116 (affirming 63 Ill. App. 585, and followed in North Chicago St. R. Co. v. Zeitger, 182 Ill. 9, 54 N. E. 1006, 74 Am. St. Rep. 157 [affirming 78 Ill. App. 463]).

and his refusal to testify unless paid an extra compensation may be punished as contempt:

Ex. P. Dement, 53 Ala. 389, 25 Am. Rep. 611; State v. Darby, 9 Ohio Dec. (Reprint) 725, 17 Cinc. L. Bul. 62.

A fortiori a professional man who attends as an ordinary witness as to facts which have come within his observation rather than as an expert in any matter relating to his profession, is entitled to only the ordinary witness' fees.

Iowa.—Snyder v. Iowa City, 40 Iowa 646.

Minnesota.—Anderson v. Minneapolis, etc., R. Co., 103 Minn. 184, 114 N. W. 744; Le Mere v. McHale, 30 Minn. 410, 15 N. W. 682.

New York.—Lyon v. Wilkes, 1 Cow. 591.

Pennsylvania.—Com. v. Lucas, 24 Pa. Co. Ct. 126.

Canada.—Gardner v. Marchildon, 5 Quebec Pr. 323. See also Marquis v. Robidoux, 3 Quebec Pr. 433.

See 50 Cent. Dig. tit. "Witnesses," Section 65.

Where, however, it is desired to have an expert witness give testimony of a nature which requires special preparation, investigation, research, or examination of any kind by him in order to prepare himself to testify, he has a right to regard such preparatory work as a professional service, and cannot be compelled to perform the same without the payment of a professional fee:

Arkansas.—Flinn v. Prairie County, 60 Ark. 204, 29 S. W. 459, 46 Am. St. Rep. 168, 27 L. R. A. 669 and note (followed in Clark County v. Kerstan, 60 Ark. 508, 30 S. W. 1046).

Colorado.—Larimer County v. Lee, 3 Colo. App. 177, 32 Pac. 841.

Georgia.—Schofield v. Little, 2 Ga. App. 286, 58 S. E. 666.

Indiana.—Gaston v. Marion County, 3 Ind. 497.

Louisiana.—Harrison v. New Orleans, 40 La. Ann. 509, 4 So. 133.

Massachusetts.—Barrus v. Phaneuf, 166 Mass. 123, 44 N. E. 141, 32 L. R. A. 619.

Missouri.—Burnett v. Freeman, 125 Mo. App. 683, 103 S. W. 121. See also Burnett v. Freeman, 134 Mo. App. 709, 115 S. W. 488.

New York.—People v. Montgomery, 13 Abb. Pr. N. S. 207.

Texas.—Summers v. State, 5 Tex. App. 365, 32 Am. Rep. 573.

Wisconsin.—Philler v. Waukesha County, 139 Wis. 211, 120 N. W. 829, 131 Am. St. Rep. 1055, 25 L. R. A. N. S. 1040 and note, 17 Ann. Cas. 712 and note.

Canada.—Guinea v. Campbell, 22 Quebec Super. Ct. 262.

See 50 Cent. Dig. tit. "Witnesses," Section 65.

"Retainer," as used in an agreement to pay a retainer to an expert witness and a per diem sum for the time he is engaged in the case, means a sum paid to secure the services of the witness, and is due as soon as the witness accepts employment, independent of any future work or its results. Hough v. State, 68 Misc. (N. Y.) 26, 124 N. Y. Suppl. 878.

Failure of witness to prepare himself and testify.—An expert witness is not entitled to the agreed compensation for his services, where his employment is dependent upon his being able to appraise certain manufacturing plants, and testify to a certain value therefor, where he fails to make such an appraisal and testify to such value. Hough v. State, 68 Misc. (N. Y.) 26, 124 N. Y. Suppl. 878.

If such services are performed without an express promise of compensation, extra compensation may be recovered upon an implied promise. Tiffany v. Kellogg Iron Works, 59 Misc. (N. Y.) 113, 109 N. Y. Suppl. 754. See also Butler v. Toronto Mutoscope Co., 11 Ont. L. Rep. 12, 6 Ont. Wkly. Rep. 527, 5 Ann. Cas. 992. But compare Fonda v. Bolton, 6 N. J. L. J. 240.

SOME EXPERIMENTS ON THE PHOTOGRAPHIC MEASUREMENTS OF ROENTGEN RAY DOSAGE*

BY L. P. LARKIN

Department of Physics, Cornell University.

ITHACA, N. Y.

THE measurement of dosage in roentgen ray therapy has come to be a very important matter owing to the increasing demands and the variety of apparatus which may be called into operation for this work. At present there are three methods in general use, namely, the use of platinum barium cyanide pastilles, the photographic measurement, and the direct measurement method. By direct measurement is meant using a purely physical specification which must include (a) the amount of current in milliamperes, (b) the effective voltage at which the tube is operated, (c) target-skin distance, (d) amount and kind of filtration used, (e) time of a single dose, (f) the frequency of repetition of dosage. There can be no question that, in the hands of properly trained operators and under proper electrical conditions, this method gives the highest degree of accuracy as regards the radiation delivered.

The purpose of the following experiments is to determine if the ordinary photographic paper is reliable enough to be used as a standard either for use as an independent measurement of dosage in therapeutic work, or as a check in connection with the direct measurement method.

In order to make the photographic method successful in the hands of the average practitioner, it is necessary to consider judicially both the advantages and disadvantages of the method, because it is fully as essential to know the limitations of a method as to know its possibilities. In this connection the following questions had to be considered:

(1) Are the papers now on the market of proper sensibility and of sufficient uniformity to be of value in this field?

(2) If they are not of sufficient uniformity, can a method be developed so that a given batch of paper may be standardized with a sufficient degree of accuracy and without undue loss of time to the operator?

(3) Will different types of apparatus under identical physical specifications as to current, voltage, distance, and time give the same photographic effect?

(4) How much change is caused in the photographic darkening by a variation of any one of these physical specifications on the same machine?

(5) What are the effects of change in concentration of developer, change in time of development, change in temperature of developer, as regards the reading?

(6) Finally, what is the relation between the indication of the paper within its proper range of sensibility and the *x*-ray dose?

Clearly the last question cannot be answered in a physical laboratory, but it is equally certain that it also cannot be answered unless the previous matters are carefully considered.

In the work here reported, the first question that arose was whether the available photographic paper would give the proper gradation and if properly handled would give sufficient accuracy of reading and certainty of results to warrant considering the matter. Several kinds of paper were tried and the one shown in the following figures was found to be the best as to gradation and sensibility. The strip shown in Figure 1 was made as a standard strip. The darkest portion on this strip received an exposure under conditions which would just produce an erythema dose if applied to the skin. Each succes-

* Presented at the Nineteenth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chattanooga, Tenn., September, 1918.

sively lighter portion received one-tenth less exposure, differing from its neighbors by one unit of radiation; that is, an exposure of 10 ma., 7-inch gap, 16-inch distance, 120 seconds, was given the darkest one, 108 seconds to the next, 96 seconds to the third, etc. The whole strip was then developed under conditions which were found to give the best results.

Having electrical conditions under control so that the work could be duplicated, a very considerable number of these strips were exposed. They were made at different times by different individuals and always with instructions as to care in manipulation. The degree of uniformity shown in these different exposures was very striking and all agreed within one shade when compared. This clearly proved that it is possible to reproduce results on a photographic paper with a high degree of accuracy, probably well within that required in the present state of our therapeutic knowledge.

The next matter to be studied was whether papers on the market were sufficiently uniform when sold under a given label to make a reliable dosage measurement with standardization in the laboratory. In these experiments only the two papers which were found to be of the proper sensitiveness were considered. Samples of these two papers bearing the same manufacturer's label were obtained from various

Fig. 1.

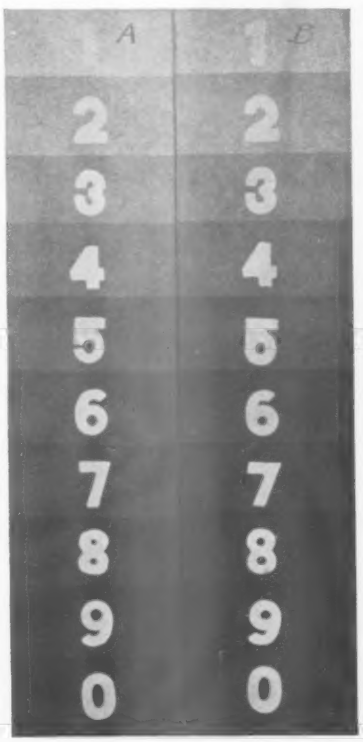

Fig. 2.

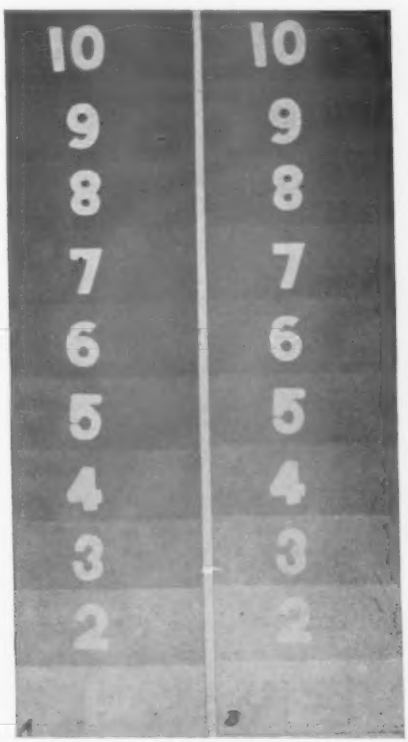

Fig. 3.

Fig. 1. Standard Strip. The exposure was made using 10 M. A., 7″ gap, 16 inches target-paper distance, No. 1 being exposed for 12 seconds, no. 2 for 24 seconds, 3 for 36 seconds, etc. The strip was developed under standard conditions using nepera solution one part—five parts H_2O at 21° C., for one minute.

Fig. 2. Strips Showing Variation Caused by Different Types of Transformers. A, exposed, using an open core type and B, with a closed core machine. All other factors as to exposure and development were identical.

Fig. 3. The Two Strips Shown Above were Exposed and Developed under Identical Conditions. Strip A was under the cathode portion of the tube and strip B under the anode end, the strips being taken from both ends of an 8 x 10 sheet of photographic paper after it was exposed and developed.

sources, exposed, and developed under identical conditions. It was found that the discrepancy between sensibilities of individual lots of one of these papers was so great as to make its use an extremely area used in ordinary work. It was found that if an 8 x 10 sheet of photographic paper was exposed, the central beam striking the center of the paper, developed, and cut into strips, the strip nearest the

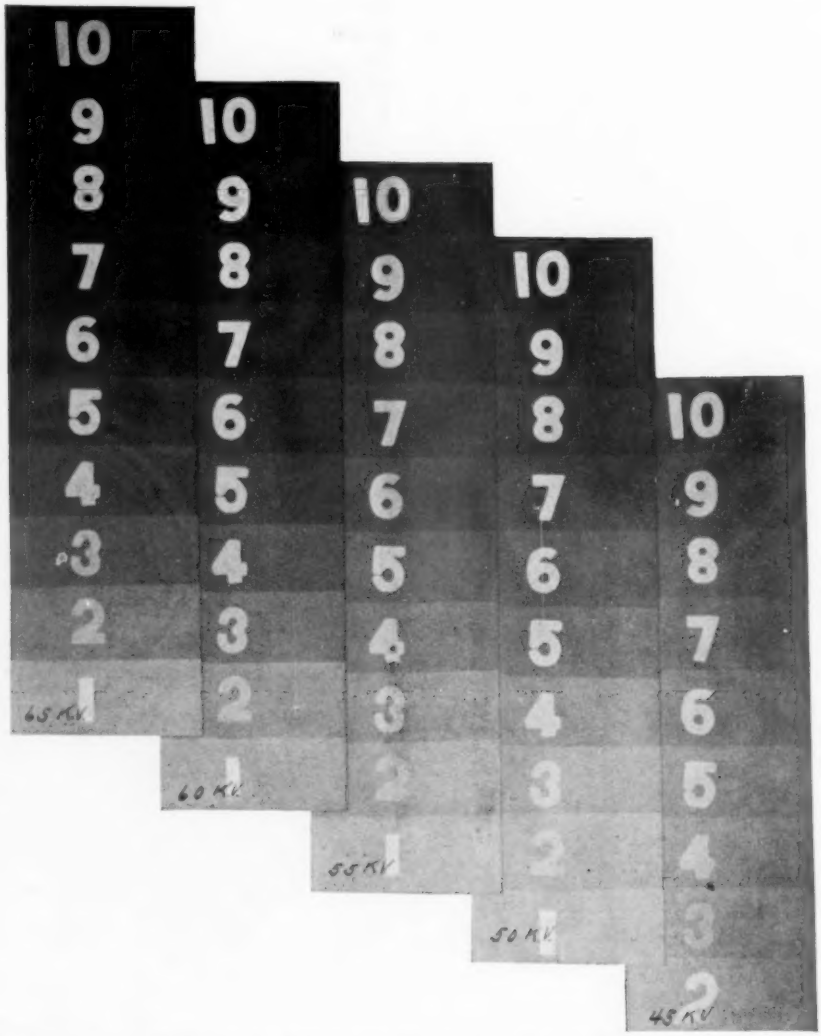

FIG. 4. THESE STRIPS WERE EXPOSED TO SHOW THE VARIATION CAUSED IN DARKENING DUE TO CHANGES IN VOLTAGE AS READ ON A HIGH TENSION, ELECTRO-STATIC VOLTMETER. THE VOLTAGE WAS VARIED FROM 45 K. V. TO 65 K. V. IN STEPS OF 5 K. V. FOR EACH STRIP. ALL OTHER FACTORS WERE CONSTANT FOR ALL FIVE STRIPS.

doubtful proposition. The second paper, Regular Carbon Velox, was found to be very uniform in emulsion and was the one used in the following experiments.

In exposing these strips, several interesting facts were noted. First, there is a variation in the amount of radiation in the cathode end of the tube is about one shade darker than the one nearest the anode end.

When using different types of machines under identical conditions as to spark gap, current, distance and time, and exposing strips, a difference of slightly more than one shade was seen on development. Two

types of transformers were used in this work. With the open core the strip was lighter than one exposed under the same conditions using the closed core type. On charting a curve of effective voltages as read on a high-tension voltmeter against spark gap reading, the explanation for this was easily seen. The effective voltage delivered by a closed core transformer is about 7 K. V. higher than that given by an open core type for the same spark gap reading.

Several strips were exposed, varying one condition at a time, such as current, voltage and distance, with the other factors constant. The result obtained agreed exactly with the law of photographic effect:

$$E = \frac{K.\ (V)^2.\ T.\ C}{(D)^2}$$

Another interesting condition noted was the marked decrease in the photographic darkening of the strip caused by the use of filters and that the greatest amount of the reduction is caused by the first third millimeter of filter. Aluminum was used as a filter and the insertion of one-third millimeter between the target and paper caused a reduction of practically four shades in darkening. The addition of a second one-third millimeter of aluminum caused a further reduction of only one shade in the photographic darkening. After the rays were filtered through one millimeter of aluminum it required the addition of another millimeter filter further to reduce the effect one more shade.

Having given a specific exposure to the emulsion on the paper, it then requires development, fixation, and washing before the final reading is obtained. It is well known that the same exposure might give

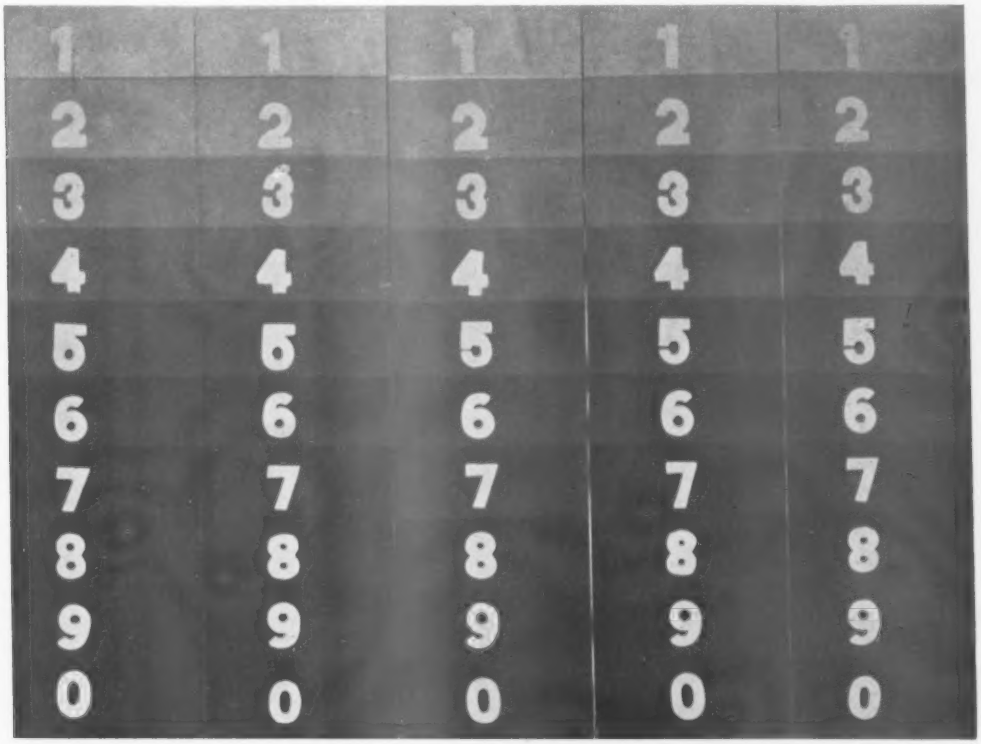

FIG. 5. THE EXPOSURE WAS THE SAME FOR ALL THESE STRIPS BUT THE TEMPERATURE OF DEVELOPER WAS CHANGED. THE TIME OF DEVELOPMENT WAS CHANGED SO AS TO GIVE THE SAME DARKENING. THE TEMPERATURE OF DEVELOPER WAS VARIED FROM 12.7° C. TO 29.3° C. INCREASING THE TEMPERATURE 4.1° C. FOR EACH SUCCESSIVE STRIP. FOR EACH INCREASE OF 4.1° C., THE TIME OF DEVELOPMENT WAS DECREASED 30 SECONDS, THE FIRST STRIP BEING DEVELOPED AT 12.7° C. FOR 120 SECONDS AND THE LAST ONE AT 29.3° C. FOR 60 SECONDS.

different degrees of blackening depending upon (a) nature of developing agent, (b) concentration of developer, (c) temperature of developer, (d) time of development.

The kind of developer as well as the concentration and time of development, when once determined so as to give the best results, can quite easily be duplicated. For this purpose, nepera solution was used in the proportion one part nepera solution to five parts water. The temperature found to give the best results was 21° C. The time of development, one minute.

In order to study the effects caused by changes in the various developing factors, several strips were exposed simultaneously and developed under different conditions. The first of these to be considered was concentration of developer. An exposed 8 x 10 sheet was cut up into five strips and each developed with developer of different concentration, all other factors being standard. The concentration was changed from one part nepera solution to three parts water to one part nepera solution to seven parts water. It was quite noticeable here that the effect is much more pronounced on the portions of the strips which were of greatest density, and the same is true to some extent as regards the strips in which the temperature of the developer was the variable factor. In other words, the effective change in blackening, due to an alteration in development, varies according to the exposure which the emulsion has received.

Next, the temperature of the developer was changed, other factors being standard. A variation ranging from 15° to 24° C. was used and it was found that the inference of dosage from these strips would be extremely erroneous, a difference of 2° C. either side of the standard, 21° C., making a difference of more than one shade on the finished strip.

The time factor was also studied and found to have a marked effect. Both the time of development and concentration of developer are conditions which may be easily controlled by careful manipulation. It is, however, very troublesome and difficult to bring the temperature to the exact point and keep it there unless special facilities, not usually found in laboratories, are provided. Inasmuch as a reasonably warm developer may give nearly the same gradation as a cooler one but in a much shorter time, the correct development time for different temperatures of developer might be determined to accommodate the variety of temperatures usually found in dark rooms. Experiments were performed to determine how much change of time was necessary for any given change in developer temperature to give accurate results. Strips which received the same exposure were found to compare exactly when developed under the following changes of temperatures and time: (a) 12.7° C. for 120 seconds, (b) 16.8° C. for 90 seconds, (c) 21° C. for 60 seconds, (d) 25.1° C. for 45 seconds, (e) 29.3° C. for 30 seconds. In short, twice the time of development is necessary for every decrease of 8.3° C. in the temperature of the developer to obtain the same photographic darkening.

From the results obtained in these experiments, it seems entirely possible that the ordinary photographic paper, having a uniform emulsion, may be used as a standard of roentgen ray dosage similar to that used in the Kienböck method. The paper used in the above work was Regular Carbon Velox and gives even a better gradation in the more dense portion of the scale than the one used by Kienböck. Considerable care is necessary in exposing such a strip to be used as a standard; but once this is done, strips of the same type of paper may be used as an indication of dosage, only being careful as to the factors of development. The method is one that might be used in any laboratory either as a separate method of measurement or as a check and record used in connection with the direct measurement method.

The work thus far studied deals only with unfiltered rays from a Coolidge tube operated on a rectified current. Later we hope to study in the same manner filtered

radiation and also measurement of radiation from the newer self-rectifying tube operated directly from the terminals of a transformer without a rectifier.

In conclusion, I wish to thank Lieutenant-Colonel Shearer for his most helpful supervision and advice throughout this work.

CASE OF TUBERCULOSIS OF THE INTESTINES WITH A DEFECT AT THE CECUM

BY PEER M. LUND, M.D.

NEW YORK CITY

PATIENT, a female seventeen years of age, suffering from pulmonary tuberculosis for the last three years was operated for appendicitis under general anesthesia about eight months ago. The appendix was found normal, but after the operation the general condition as well as the pulmonary symptoms became worse and the patient developed also a persistent enteritis and colitis, causing a very marked loss of weight and weakness. Tubercle bacilli were found in the stools.

Roentgen ray examination of the gastro-intestinal tract showed a very rapid emptying of the small intestines as well as of the colon, the barium-zoolak meal being in the descending and sigmoid colon three hours after the ingestion.

Fluoroscopic and radiographic examination of the colon by means of a barium-enema showed a definite filling-defect at the lower pole of the cecum and a general irregularity of the outline of the cecum and the ascending colon; there was marked tenderness in the right iliac fossa.

Operative findings were as follows: Tuberculosis of the transverse and ascending colons, cecum and ilium, with a large mass involving the junction of the distal ilium and the cecum; many small tubercles were seen on the large intestines.

Pathologists report, tuberculosis.

Operation.—Resection of the last 12 inches of the ilium, cecum, the ascending and part of the transverse colons.

REPORT ON A METHOD OF FLUOROSCOPIC EXAMINATION WITH THE ARMY BEDSIDE UNIT

BY F. F. BORZELL

Headquarters Base Hospital 38, A. E. F.

GRAND BLOTTEREAU, NANTES, FRANCE

THERE has been, perhaps, no one phase of war radiology which has attained such a field of usefulness as has bedside radiology, with the possible exception of localization of foreign bodies. Even the refinement and simplification of localization and removal of foreign bodies as developed by war necessities have to a great extent fulfilled their usefulness with the end of the war; but the development of bedside examination has opened a vast field for radiology. It is largely as an expression of appreciation of the value of the Army Bedside Unit that I am presenting this report.

During the last three months, which represents the actual time this hospital has been doing active service, we have examined a few more than 150 cases at the bedside.

The examinations have been radiographic with and without the intensifying screen and fluoroscopic, for fractures, foreign bodies and pulmonary conditions of those patients who could not be transported to the laboratory. One is often called upon to exercise every bit of ingenuity he possesses to secure two views to determine position. Stereoscopic studies have assisted many a time. With the aid of Bowen plate-

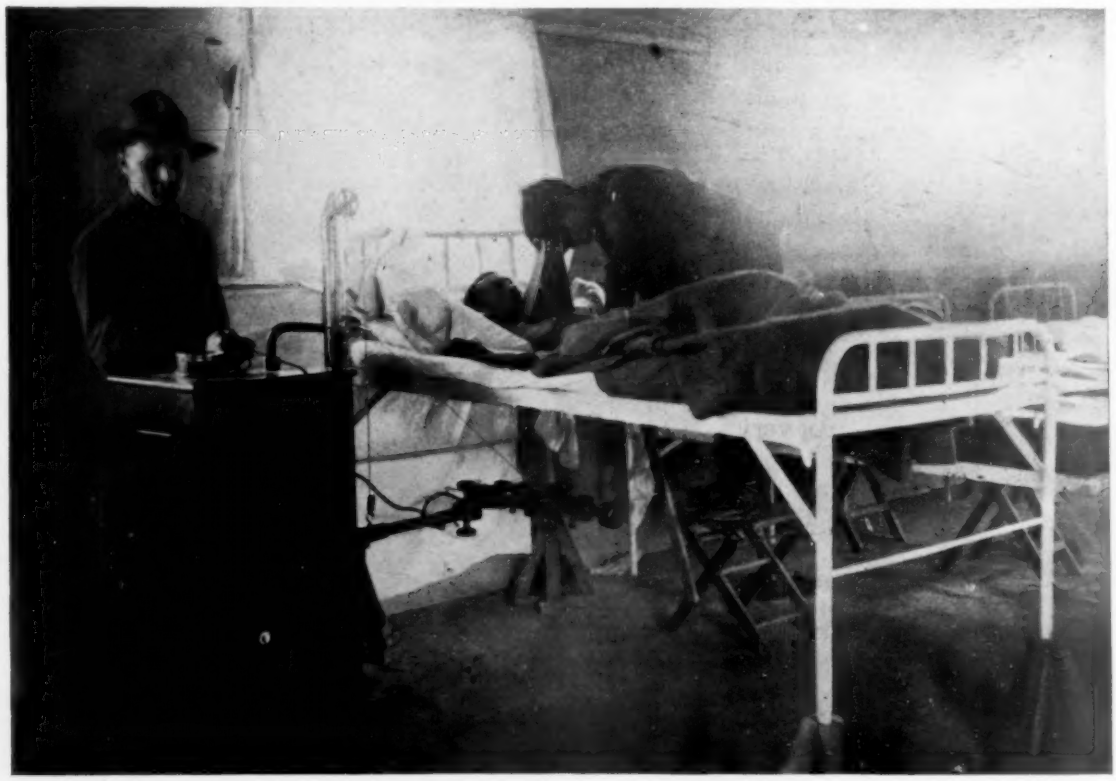

FIG. 1. FLUOROSCOPIC EXAMINATION AT BEDSIDE

holders, and by marking the horizontal sliding bar on the tube carriage, the required shift can readily be made.

Radioscopic studies have been made with the Dessane bonnet fluoroscope for fracture position, foreign bodies and pulmonary conditions. I have found one method of examination for pulmonary conditions very valuable. We have had a number of patients who required radiologic studies to determine the presence of fluid, empyema, hemothorax, bronchopneumonia, lobar pneumonia, pericardial effusions, pulmonary abscess, subphrenic abscess or foreign bodies. Many of these patients were either too sick to be moved or even turned upon their side, or else by reason of being splinted and slung in Balkan frames, and other fearfully and wonderfully contrived devices, could not be moved.

FIG. 2. SHOWING METHOD OF TRANSPORTATION BETWEEN BARRACKS

By the use of four stilts, which, when placed under the legs of the bed, raise the bed twelve inches, I can drop the tube beneath the bed and fluoroscoping through the mattress secure very satisfactory information.

The bed springs of the regulation bed do not interfere materially with the study, due to the fact that, being some distance from the screen and a greater distance from the screen than the tissues to be examined, the mesh shadow is very much exaggerated and but few of the lines of the spring intercept vision. I found the average distance between spring shadows 20 cm. In the case of a search for foreign bodies a slight shift of the tube will shift the shadows of the spring.

By this method the patient is not at all disturbed, nor is the position of the fractured limb disturbed. Where the Balkan frame is used, the frame, which is lashed to the bed, is lifted with the bed and rests with the legs of the bed on the stilts.

Our hospital being of the barrack type, it is necessary to carry the bedside unit from ward to ward. This is readily accomplished by suspending the unit by the handles on a litter made of timbers of sufficient strength and fastened together by two crosspieces. The carrier was made in a few minutes by one of my men. It consists of two timbers 2″ x 3″, 5 feet long set 16 inches apart and held together by two crosspieces 3 feet apart.

CONCLUSIONS

Bedside examination by this method affords:

1. Easy access to the entire torso and limbs, fluoroscopically.
2. Patients can be examined who would otherwise be unavailable.
3. There is no risk to very sick pulmonary cases.

SAFETY PIN IN THE LUNG FIVE YEARS

BY A. F. TYLER, M.D., B.Sc.

OMAHA, NEB.

THE following case is of interest both because of its rarity and because of the pathology which had gone unrecognized until the patient was brought for roentgen examination.

HISTORY.—C. B., age ten years. When five years old the mother says he "swallowed a safety pin." Later she watched the passages but she never recovered the pin. She noticed that the boy wheezed for a time after the accident but did not give this any significance, for she thought that the pin had probably escaped her notice when examining the stool. Two years after swallowing the pin the child was taken with what was pronounced bronchial asthma. This condition has persisted until the time of our examination.

Physical examination showed the boy undernourished, with Harrison's groove present on the left side. Auscultation showed moist râles over the entire left chest. Percussion showed the whole left chest dull.

Roentgen examination showed the entire left lung radiopaque with an open safety pin resting point upward in the central portion of the left lung, probably in the bronchus.

Operative interference was refused by the parents.

A review of the available literature shows reports of many foreign bodies inhaled into the lungs, but few that have gone unrecognized for such a long period of time. R. H. Good advises roentgen examination in every suspected case, and early removal. Fiorini and Rossi report a case of foreign body inhaled into the left lung five years previously. They did a transpleural pneumonotomy, removing the foreign body, and the patient recovered. Telega reports a case of foreign body several years in the bronchus. Richards reports a case of a young man twenty-five years of age who had inhaled a foreign body when a child. The patient came complaining of a purulent expectoration. Blood examination pointed to a focus of infection, and roentgen examination revealed the foreign body, a tack, in the right bronchus. This was removed and the patient made a good recovery. Packard reports the removal of a fragment of tracheotomy tube from the lung six years after its inspiration. Walters reports the removal of a foreign body in the lung by bronchoscopy eleven years after its inspiration.

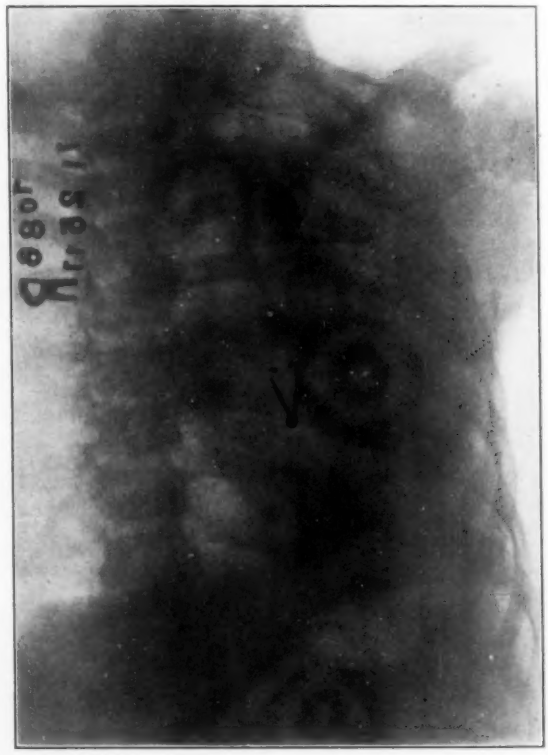

FIG. 1. Roentgenogram of the chest of patient aged ten years who had supposedly swallowed an open safety pin five years previous. Notice the pin resting in the central portion of the left lung, that the point rests upward and that the entire left lung is radiopaque.

The cases cited above are those reported in which the foreign body had remained in the bronchus or lung five years or more.

The greatest length of time was twenty years, the next eleven, the next six and another five years. In all of these cases marked pathological changes had taken place in the lung corresponding to the changes in the lung of the boy here reported. In the case reported by Richards, lung abscess had supervened, in the others marked consolidation of the lung with bronchial inflammation.

In the patient coming under my observation, the foreign body was an open safety pin which rested in the left lung, the point upward. Although operation was refused by the parents, I feel that transpleural pneumonotomy would be the operation of necessity, since bronchoscopic removal would be impossible. This case emphasizes the importance of Good's postulate that roentgen examination should be made in every suspected case and the foreign body removed as early as possible.

ACUTE INFECTIOUS ARTHRITIS FOLLOWING PNEUMONIA

BY PEER M. LUND, M.D.

NEW YORK CITY

MALE, Russian, age thirty-nine.

HISTORY.—Negative, until ten weeks previous to admission, when patient had pneumonia, complicated with a left-side pleurisy, lasting about five weeks. While convalescing from the pneumonia, about six weeks ago, he began to have pain in the right hip and lower extremity, but no swelling and only a very slight rise in temperature.

On admission the right hip was found red, swollen and very tender to touch.

Temperature was 102°.

W. B. C. 10,000.

Sputum.—Examined three times; found negative for tuberculosis.

Chest Examination.—Negative.

Clinical Diagnosis.—Acute infectious arthritis.

Roentgen ray examination of the right hip showed a marked destructive process of the upper part of the head and neck of the femur, with a slight upward displacement of the bone. The acetabulum was flattened out and enlarged in its upper aspect. There did not seem to be any recent focus in the hip, and there were

no signs of new bone production. There did not seem to be any distension in the joint.

Diagnosis.—Acute infectious arthritis.

A PRACTICAL METHOD FOR TESTING THE EFFICIENCY OF AN INTENSIFYING SCREEN

BY ROBERT T. MORRISON

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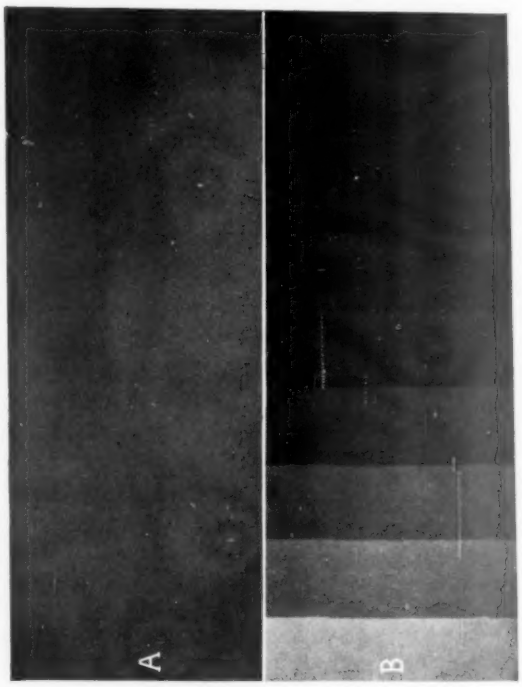
INTENSIFYING screens are not always found to have the same multiplying effect on exposure when used in the usual manner. There are a number of contributory causes to this result, namely, the wave length energy spectrum of the fluorescence, the volume of the total fluorescence and the wave length sensibility spectrum of the photographic material used. Speed, then, is dependent upon the coordination of these three factors and as such may be measured conveniently by a simple photographic method.

For some special work recently it was necessary to develop a method which was quick and at the same time reliable for testing the efficiency of intensifying screens under standard conditions.

The proof of the advisability of adopting any method of testing is governed by the accuracy of results weighed against the mechanical difficulties of measuring; further, if the process has few chances of leading to fallacious conclusions, the probable accuracy of the final result is greatly increased. The process here described was found to give satisfactory and reliable results.

In the present method a film or plate was placed in the cassette with the screen to be measured. One-half of the film or plate was "insulated" from the screen by means of black paper of sufficient opacity to prevent the fluorescence from affecting the sensitive emulsion, but not of sufficient opacity so that its roentgen ray absorption was of moment. A "unit exposure" was then determined, being that which just impressed a noticeable image on the plate. The half of the plate not covered by the black paper was then protected by a piece of lead. The remaining unprotected area was then given a series of exposures in one inch strips, increasing regularly in multiples of the unit exposure.

After exposing the last step, the half of the plate in direct contact with the intensifying screen was given one unit exposure. The plate was then developed under standard conditions. One-half of the material then showed a density resulting from the exposure to one unit with the screen and the other half showed densities ranging from one just noticeable to one nearly opaque. It was then a simple matter to match the density of the unit exposure with the screen, with some particular step on the graded strip made without the screen. In the illustration given, this unit exposure with the screen matched step No. 3 on the graded strip without the screen. The screen



A. UNIT EXPOSURE WITH SCREEN.
B. MULTIPLES OF UNIT EXPOSURE WITHOUT SCREEN.

can thus be stated to have a speed factor of three since it requires three times the exposure without the screen to give the same density as with the screen.

For the purpose of the experiments in question, the unit exposure referred to was one second at 30 inches distance, 2½ milliamperes, 5 inch spark gap, using Eastman Dupli-Tized X-Ray Film, and standard developement was five minutes at 65 degrees in a standard Metol-Hydrochinon formula.

My thanks are due to Mr. Millard B. Hodgen for his helpful criticism and aid to suggesting improvements in the text.

THE ROENTGEN STUDY OF VISCEROPTOSIA *

BY P. L. ANSELL

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IN the roentgen study of visceroptosia, observance of several factors is necessary if one would avoid the common diagnostic errors of this disorder. A brief description of the most important features, together with a few illustrations, will serve to bring to your attention the value of roentgen ray study of this type of patient.

Constant observation of a great many cases and correlation of our findings with the accepted literature upon this subject forcibly bring out certain features.

First, that four major groups of bodily physique predominate, and that the majority of individuals can readily be placed somewhere in these groups. Stiller, in his extensive research work, has classified these groups as hypersthenic, sthenic, hyposthenic and asthenic.

Second, that each group shows certain characteristic proportional dimensions of thorax and abdomen with relative capacities, particularly of the upper and lower abdomen and pelvic cavities.

Third, that definite types of visceral form, position and tonus are fairly constant to each group. Schlesinger, in his research work on the stomach, has classified stomach as hypertonic, orthotonic, hypotonic and atonic, corresponding in the order named to the four types of habitus above mentioned.

Fourth, that morbid changes not infrequently complicate ptoses and one should be constantly on the alert for evidence of such change.

Group I, or Hypersthenic Habitus.—The general physical qualities of this group are massiveness of build; wide intercostal angle; thorax short, broad and deep; abdomen long, with relatively narrow pelvis.

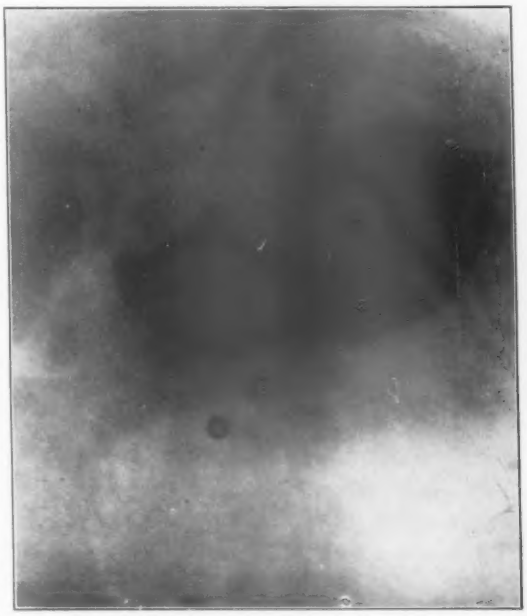

FIG. 1. TYPE OF STOMACH COMMONLY SEEN IN GROUP I.

Roentgenologically, we see a heart trans-

* Read before the Alameda County Medical Society in conjunction with a paper by Dr. H. Gordon MacLean.

versely placed, lungs that are short and broad at the bases and narrow in the upper lobes, a digestive system high in the abdomen and of quite marked tonus. The stomach is small, usually of the steer-horn type and transversely placed. Peristalsis and motility are fairly rapid. The emptying time of this type of stomach is from three to three and one-half hours and corresponds to Schlesinger's classification of hypertonus.

Very little of the small intestine is seen in the pelvic basin and the cecum is well up in the right iliac fossa. The colonic flexures are quite high, particularly the splenic flexure, which is frequently on a level with the fundus of the stomach. The transverse colon as it passes across the abdomen is most frequently above or on a level with the umbilicus and rarely more than an inch below that point. The haustra are small and numerous. The descending colon passes down the left side in a long sweep to the pelvis, and the sigmoid in the majority of cases is short. Twenty-four hour colon residue in this type is usually small and not infrequently the motor meal has entirely left the system at that period.

Group II, or Sthenic Habitus. — The physical qualities of this group are very similar to those of the preceding group, but with visceral characteristics tending toward the ptotic types. Physically, the thorax is longer and less broad and deep, the intercostal angle somewhat more acute and the abdomen is shorter.

Roentgenologically, we see a heart that does not differ greatly from Group I, but is somewhat more vertical. The lungs are longer and the difference between the upper lobes and the bases is less marked.

FIG. 2. TYPE OF STOMACH COMMONLY SEEN IN GROUP II.

FIG. 3. ANOTHER TYPE FREQUENTLY SEEN IN GROUP II BULBOUS TYPE.

The digestive plant is lower in the abdomen and of a different form. The stomach, while frequently of the tubular type, at times may be of the bulbous or fish-hook forms, and is more vertically placed with the lesser curvature varying from about one inch above to about two inches below the umbilicus. This type corresponds to Schlesinger's orthotonic type. Motility and peristalsis are not quite so rapid, although not infrequently they vary very little from Group I in these two features. The emptying time may be anywhere between three and one-half to four and one-half hours. The small intestine, colon and flexures are

usually lower and the haustra less numerous and more marked. Colon stasis at twenty-four hours is nearly always greater.

Group III, or Hyposthenic Habitus.—The physical qualities of this group are in marked contrast to the two preceding groups. Frail and slender physique, thorax long and flattened, long and narrow intercostal angle with a decided downward slope of the ribs, abdomen short and pelvic basin frequently broad and flaring.

Roentgenologically, we see a heart of the vertical type, lungs that are long and narrow at the bases and broad in the upper lobes, the digestive system low in the abdomen and frequently of poor tonus. The stomach, chiefly of the fish-hook type, is long and after the ingestion of an opaque meal appears partly collapsed in the *pars media*, sometimes markedly so, with the lower pole distended with the meal and the upper pole to a less degree by gas. The lesser curvature is usually below the interiliac crest line and often well down in the pelvic basin. Not infrequently in this type, the pylorus is ptosed, in some as low as the interiliac crest line.

The commonest location of the stomach in this type is the pylorus in the median line and about the level of the umbilicus, with the body of the stomach in the left iliac fossa. Peristalsis and motility at best are rarely as good as in the two previous types. The emptying time is between five and six hours, sometimes longer, depending upon the degree of tonus. This type of stomach corresponds to Schlesinger's hypotonic group.

The small intestine is mostly in the pelvis and the cecum frequently low in the pelvis and toward the median line; with the transverse colon commonly resting on the pelvic organs. Of all cases examined by the *x*-ray, this is the most frequent type seen.

Group IV, or Asthenic Habitus.—In this group we have all the characteristics of Group III, but to a more marked degree, less pronounced in the thoracic viscera than in the abdominal cavity and its contents.

This is the type referred to by Stiller as asthenia universalis congenita, and is the group most frequently suffering from symptoms.

Roentgenologically, we see a stomach markedly elongated, often dilated, of very poor tone, with the greater curvature often in the true pelvis. A six-hour gastric residue is not common although the emptying time is slower than in Group III. This type of stomach corresponds to Schlesinger's atonic group.

FIG. 4. TYPE OF STOMACH COMMONLY SEEN IN GROUP III.

The small intestine is largely in the pelvis and the ileum can be manipulated with difficulty, often not at all, with the colon correspondingly lower and usually spastic in type although in some the atonic type of colon is seen. A forty-eight hour residue is fairly common and not infrequently there is a seventy-two hour colon stasis.

While the foregoing classification of groups is generally accepted, there are still a few who adhere to a one-type standard by which they gauge ptosis and

that standard corresponding to Group IV. The fact that a great many patients with symptoms belonging to Group III and even a few in Group II have been relieved of their symptoms by treating them as enteroptotics should be sufficient evidence to disregard such a standard.

There is another type of ptosis in which the stomach is of fairly good position and tonus but with a pronounced prolapse of the colon. This type illustrates the necessity of a complete examination. Because the stomach is of fair position, it is unwise to discontinue the examination with the assumption that there is no ptosis. An interesting factor we have noticed in the great majority of ptotic individuals is that the head of the barium column reaches the sigmoid in normal time and frequently even in seventy-two hour stasis the entire colon is fairly well filled with the opaque meal.

The next important factor to be considered in connection with Groups III and IV, particularly Group IV, is a morbid change which may complicate ptosis. This factor is too often neglected in the presence of visceroptosia and many cases have been placed under treatment for visceroptosia with a temporary relief, but a recurrence of symptoms upon resuming their normal habits of diet. Especially is this likely to occur when an undiagnosed duodenal ulcer complicates the ptosis, as the necessary dietary to relieve the ptosis masks the ulcer symptoms, since most duodenal ulcer patients have no distress during the period in which food is in the stomach.

Gastric hypertonus, together with hyperperistalsis, should always be viewed with suspicion, particularly in Group IV, and careful search made for duodenal ulcer. If only moderate and transitory, search should be made for evidence of a chronic appendix or gall bladder disease. Many times apparent deformities of the pylorus and duodenal cap result from extreme ptosis and lack of tone. These deformities are most common when the pylorus and duodenal cap are of fairly normal position, but the stomach is of poor tone and quite low in the pelvis, with insufficient gastric contraction to force enough of the meal to

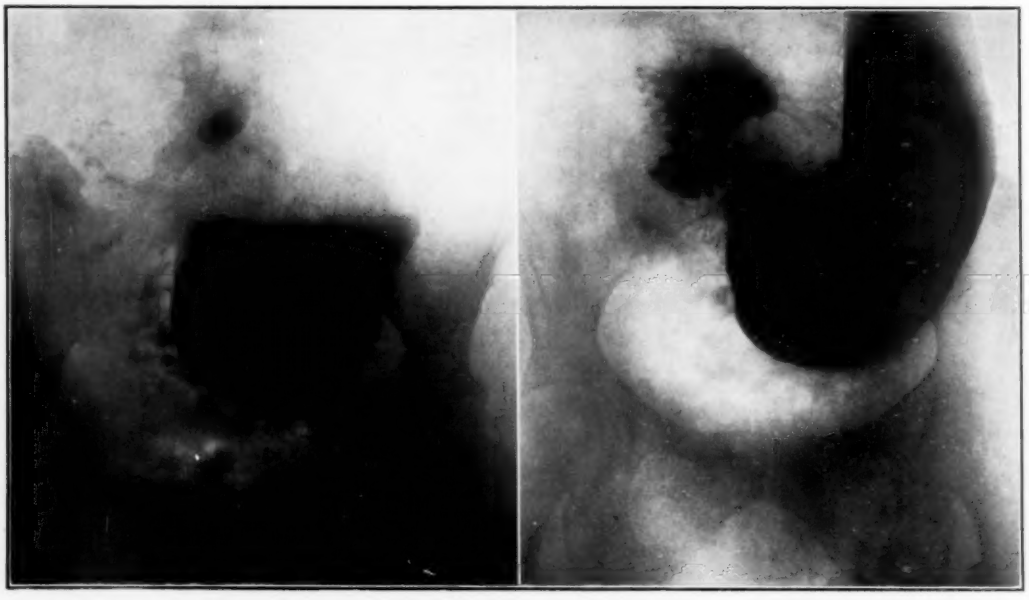

FIG. 5. TYPE OF STOMACH COMMONLY SEEN IN GROUP IV.

FIG. 6. ANOTHER TYPE FREQUENTLY SEEN IN GROUP IV. LESS ATONIC

fill properly the pyloric antrum and duodenal cap. But with careful fluoroscopy and manipulation one can usually differentiate such deformities from those produced by gastric or duodenal ulcers.

Six-hour gastric residue, particularly if large, should always be viewed with suspicion, and careful search will usually be rewarded with evidence of ulcer, often situated at the pylorus. This is especially important when we consider Carman's report of some 250 cases of enteroptosis at the Mayo Clinics, in which 15 per cent were complicated by ulcer.

Not infrequently we fluoroscope patients with a visceroptosia and find evidence of gastric ulcer, the localized tenderness over the ulcer corresponding to McBurney's point and often leading to a diagnosis of appendicitis upon physical examination. In such cases the terminal ileum and cecum are usually much lower and a differential interpretation between ulcer and appendicitis, while clinically difficult without fractional analysis of the stomach contents, etc., can be made in most cases roentgenologically.

Terminal ileum stasis at twenty-four hours is rare in visceroptosia of any degree and its presence must be cautiously considered. If small in amount, spastic in type, in conjunction with localized tenderness in that region and in the absence of large six-hour gastric residue, it strongly points toward a diseased appendix. If large in quantity and not spastic in type and in the absence of large six-hour gastric residue, it points toward ileocecal valve incompetency, even if there is some localized tenderness. Ileocolic membranes and adhesions should also be considered and when possible ruled out.

Other conditions which do not come within the scope of the roentgenologist, only as they may involve adjacent structures, are inflammations of the pelvic organs which may result in adhesions to the ileum, cecum or sigmoid.

In routine examinations, nephroptosis is occasionally seen, chiefly right-sided and in some cases as much as three inches variation is noted between the supine and the standing positions.

Another very important feature is routine examination of the thorax. When one considers the type of thorax characteristic of Groups III and IV, no roentgen examination is complete until careful fluoroscopy of the lungs, heart and great vessels has been made and any abnormalities noted. Particularly should the lungs and mediastina be viewed for evidence of tuberculosis, enlarged glands or adhesions, all of which might have considerable bearing on the case.

CONCLUSION

The success of any rational treatment for visceroptosia depends primarily upon the clinician being reasonably sure he has no complications. That a percentage of failures is due to undiagnosed complications, there can be no doubt. A good history of patients unquestionably belonging to Groups III and IV, together with a careful roentgen study of the abdominal viscera, will do much toward decreasing the percentage of failures; and in the light of the foregoing factors, roentgen study of such cases should be rather the rule than the exception.

SOME EFFECTS OF ROENTGEN RAYS ON CERTAIN BACTERIA*

BY M. W. PERRY, M.D.

PHILADELPHIA, PA.

IN a recent comparative study of the immunity-producing properties of bacterial vaccines prepared in a number of ways, an unsuccessful attempt was made to sterilize a vaccine by roentgen rays.[1] This, with the modern use of the roentgen ray in so many diseases of bacterial origin, suggested the value of a review of the literature on the subject of the effect of roentgen rays on bacteria. And as a result of the review it was decided to do a few simple experiments in an attempt to clear certain points regarding which many conflicting reports were found. Among the earliest results reported on this subject are those of Reider[2] who, in a set of experiments which he later repeated, reported very marked bactericidal effects of roentgen rays. Rudis-Jicinsky[3] also reported positive bactericidal effects, finding that a number of organisms were killed in acid and alkaline media in glass with exposures varying from 35 to 60 minutes, with some variation of effect in media of different reactions. Since that time much work has been done on the subject and no single report confirms the findings already mentioned. Minck[4] found that bacillus tuberculosis on agar was not killed by exposure up to 64 hours. Blakie[5] found no effect on the same organism rayed in aluminum containers for 8 hours. Wilson[6] reported no effect on bacillus typhosus rayed through cotton plugs in test tubes one hour and a half. Bean[7] found no change in a number of bacteria from exposures of 10 to 60 minutes with all of the common roentgen ray tubes. Blaize and Sambuc,[8] Forbes-Ross,[9] Zeit,[10] and others have reported no effects on practically all of the common pathogenic bacteria by exposures much greater than the dose possible in the human.

As a result of this mass of evidence it has come to be regarded as rather definitely settled that roentgen rays have no direct effect on bacteria in inert media. Practically all of the manuals on the subject so summarize the matter. Yet it is common knowledge that carbuncles, boils, old ulcers, the pustules of sycosis, infected malignant growths and the like quickly become practically clean under roentgen ray treatment. And definite cures are claimed in chronic infections, as lupus and tuberculous adenitis. Stimulation of phagocytosis and increase of blood flow seem an inadequate explanation, as well-known means of promoting such fail to give the same definite results. Accordingly the question has arisen as to whether different effects are produced by roentgen rays on organisms in the tissues. And in this connection Lortet and Genaud[11] have reported that roentgen raying after inoculation of the inguinal region of guinea pigs with the tubercle bacillus prevents the development of tuberculosis in these animals.

The latest allusion to this subject is made by Newcomer,[12] who has found that "*X*-rays alone have a partial bactericidal action on water suspensions of bacillus typhosus." He worked by a method of plating, and the effects were reduction in numbers and never complete sterilization. This was an evidence of direct effect which had not hitherto been found.

Experiments were done with the following questions in mind:

1. Do roentgen rays kill bacteria in inert media in dosage comparable to the maximum dose therapeutically used in humans?

2. Do roentgen rays kill bacteria in living tissues?

3. Do roentgen rays render bacteria

*Read before the Undergraduate Medical Association, University of Pennsylvania, May 1, 1919.

more susceptible to killing by other means?

To determine the first point the following was done: Twenty-four hour boullion cultures of bacillus typhosus and staphylococcus aureus were smeared on the surfaces of agar Petri dishes, the covers replaced by sterile papers and one-half of each dish covered by a one-fourth inch lead plate. The plates were then roentgen rayed and incubated. Exposures of 40 and 60 milliampere minutes with the tube at a distance of 8 inches and with a 9-inch spark-gap and 3 mm. aluminum filters* gave no obvious difference in development of colonies on the exposed and unexposed halves of the plates. The same was true of exposures of 10, 15, and 60 milliampere minutes with a 3-inch spark-gap and no filters.

Following this, sterile squares of muslin were soaked in 24-hour boullion cultures of B. typhosus and staphylococcus aureus, and separate squares were placed in sterile Petri dishes. The covers of the dishes were replaced by sterile papers and the squares exposed. After exposures the squares were dropped in tubes of boullion and incubated. Exposures of 40, 60, and 120 milliampere minutes at a distance of 8 inches and with a 9-inch spark-gap and one glass filter did not kill the bacteria in any case. It was evident, as had been expected and in accordance with the literature, that roentgen rays in dosage even in excess of the maximum human dosage do not kill bacteria directly. (The maximum human dose under the conditions given above would be about 50 milliampere minutes with the glass plus 3 mm. aluminum filter.)

For the determination of point 2, as to whether a different effect was exerted on bacteria in living tissues, the following was done. The livers and spleens, and some of the lymph glands of two advancedly tuberculous guinea pigs were removed under sterile conditions and ground. To each gram of this pulp 100 c.c. of sterile saline were added and the whole filtered through sterile cotton, ½ c.c. of this suspension was injected subcutaneously in the left inguinal regions of nine guinea pigs. Four days later, before any signs of local glandular enlargements were evident, two of the pigs were roentgen rayed over the region of inoculation, one 50 milliampere minutes with a 9-inch spark-gap and at a distance of 8 inches, and the other for 25 milliampere minutes under the same conditions. One glass and 3 mm. aluminum filters were used to prevent burning in this and subsequent experiments, and all parts of all animals except the left inguinal regions were covered by a ¼-inch lead plate. The two animals developed local tuberculosis as rapidly as did controls. The roentgen rays in these therapeutic doses did not prevent the development of tuberculosis.

The other seven animals developed marked local glandular enlargements in twenty-one days. Five of these were then roentgen rayed under the conditions described above. Two were not roentgen rayed but taken as controls. Two were roentgen rayed 25 milliampere minutes, two 30, one 50, and one 75. Thirteen days later all pigs were killed and the left inguinal glands dissected out under sterile conditions. Cultures were made from each on Petroff's media and the glands were ground separately in sterile mortars with sterile saline and the resulting fluid injected intraperitoneally (1 c.c.) into nine other pigs. While there was some variation in the result of the cultures, in no single case did the inoculation fail to produce tuberculosis in the second set of animals. In other words, roentgen raying in the above therapeutic dosage did not destroy or prevent the growth of tubercle bacilli in local glandular lesions. Our results failed to confirm those reported by Lortet and Genoud.

The following table shows the results of the above animal tests.

For the determination of the third point, as to whether bacteria, although they could not be killed, were affected in some

* All filters were of the usual thickness of about 3 mm.

Pig	Inoc. left ing. reg. subcut.	Roentgen rayed Coolidge tube	Dose *	Autopsy 3/26	Culture of glands	Inoculation of suspension of glands
1	2/20	2/24	50 mam†	t-b		Positive t-b
2	"	"	25 "	"	Negative	" "
3	"	3/13	30 "	"	Positive	" "
4	"	"	30 "	"		" "
5	"	"	50 "	"	Positive	" "
6	"	"	50 "	"	Negative	" "
7	"	"	75 "	"	Positive	" "
8	"	Control	0 "	"	Positive	" "
9	"	"	0 "	"		" "

* *X*-rayed at a distance of 8 inches with a 9-inch spark-gap. One glass and 3 mm. aluminum filters were used.
† mam-milliampere minutes.

way whereby they became more susceptible to other influences, the following table will show; in doing these experiments twenty-four hour cultures were placed in wide mouthed cups and roentgen rayed through cotton plugs. All were roentgen rayed 60 milliampere minutes with a spark-gap of 9 inches and at a distance of 8 inches. One glass filter was used. Such a dosage corresponds to more than a full human dose. A part of each culture was retained as a control and not roentgen rayed. Both were then placed in a water bath at 56° C. and at definite intervals cultures were removed.

Heat at 56° C.	10	12.5	15	17.5	20	22.5	25	27.5	30	32.5	35	37.5	40	42.5	45 Min.
Staph. *x*-rayed	+		+		+		+		+		−		−		−
" control	+		+		+		+		+		+		−		−
" *x*-rayed			+	+	+	+	+	+	+	+	+	+	+	−	−
" control			+	+	+	+	+	+	+	+	+	+	+	+	+
Typh. *x*-rayed	+	+	+	+	−	−	−	−	−	−					
" control	+	+	+	+	+	−	−	−	−	−					
" *x*-rayed	+	−	−	−	−	−	−	−							
" control	+	+	+	−	−	−	−	−							

From this table it seems that there is an increased susceptibility to heat produced by roentgen rays in dosage comparable to those used in humans. Possibly in the same way roentgen rays in the treatment of diseases of bacterial origin increase the susceptibility of the organisms to the defensive processes of the body.

CONCLUSIONS

1. Roentgen rays in human dosage do not prevent the development of B. typhosus and staphylococcus aureus on inert media. Roentgen rays in twice the human dosage will not kill cultures of the same.

2. Roentgen rays in human dosage do not prevent development of experimental glandular tuberculosis. Neither do they destroy the organisms in fully developed glandular tuberculosis.

3. Roentgen rays seem definitely to increase the susceptibility of B. typhosus and staphylococcus aureus to killing by heat. Possibly this may indicate a method by which therapeutic results are obtained in the roentgen ray treatment of bacterial conditions.

I wish to thank Dr. John A. Kolmer and Dr. H. K. Pancoast for the use of the facilities of the Departments of Immunology and Roentgenology of the University of Pennsylvania and for suggestions and advice. I wish also to thank Miss Katherine Stiner of the Department of Roentgenology for kind assistance.

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JEROME MCKAIG LEONARD

Dr. Jerome McKaig Leonard, Lieutenant M. C., U. S. A., age thirty-four, whose home was given as Douglas, Arizona, was killed in action in France November 8, 1918. Dr. Leonard, who was a graduate of the Hahnemann Medical College, Chicago, 1906, did excellent work as a roentgenologist in France. He was on duty for a while at the *x*-ray school in Paris, was later transferred to the 305th Field Hospital, 302nd Sanitary Train, 77th Division, for *x*-ray work with the Field Hospital. On account of changing tactics, whereby the Mobile Surgical Hospitals were brought closer to the front, Lieut. Leonard was temporarily detached from the Field Hospital and placed on temporary duty with the 307th Infantry of the same division, to which regiment he was attached on the date of his death.

JAMES T. CASE

TERMINOLOGY

Now that the great world struggle is at an end, roentgenologists in general and THE AMERICAN ROENTGEN RAY SOCIETY in particular are confronted by a problem that was considered settled several years ago. This is the question of terminology. Many years ago the *x*-ray men of Germany and Austria adopted the prefix "roentgen" in connection with all words applicable to the use of *x*-rays. Like all other forms of German propaganda, if this may be considered in the same light, the custom spread to Great Britain and perhaps to France, and finally we American *x*-ray men concluded that we were not abreast of the times unless we became roentgenologists and used the prefix "roentgen" in connection with all words implying the use of *x*-rays. Those of us who recall the adoption of this terminology will doubtless remember that considerable pressure came from the direction of the American Medical Association.

There seems to be a disposition on the part of some of our members to drop the prefix "roentgen" and substitute another, such as "radio." There is much to be said on this subject pro and con.

There is no doubt that we should have uniformity in literature, at least in the English language. Our allies in Great Britain dropped the prefix "roentgen"

immediately after the onset of the war, and are not likely to adopt it again. At least these two great English speaking nations should use a uniform nomenclature. There is no reason why we should go back to methods of Teutonic origin, and in fact there was no reason in the first place for adopting their terminology, which was in an entirely different language. No doubt the French roentgenologists would be willing to adopt if possible a nomenclature corresponding to ours.

While we can afford to a certain extent to be independent as an organization, it would seem futile to coin new words or employ words new to us that would not be acceptable to the American Medical Association. It would mean a change of terms from articles in our own Journal to those insisted upon by the American Medical Association when the same or a similar article was published in the Journal of the A.M.A. It would certainly create confusion throughout medical literature, in this country at least.

It would seem wise, therefore, for us not to be too hasty in making changes in the present nomenclature. We should certainly consult our British confrères and decide together upon a uniform terminology, and then approach the American Medical Association as the entering wedge into American medical literature.

The use of radium has reached such proportions as to make a special terminology essential in connection with its use as a therapeutic agent. There is much to be said in favor of a special terminology applicable to the use of radium, and the prefix "radio" may be the one best adapted to this purpose.

H. K. PANCOAST.

TRANSLATIONS & ABSTRACTS

BROWN, LAWRASON, M.D., and SAMPSON, HOMER L., Trudeau, N. Y. The Early Roentgen Diagnosis of Ulcerative Tuberculosis Colitis. (*J. A. M. A.*, Vol. 73, No. 2, July 12, 1919.)

[On account of the great importance of this question the editor takes the privilege of reprinting all that the authors say concerning the roentgen aspect of the question, together with the tables.]

For some years, the medical profession has had at its beck and call a technic which discloses the variations in the motility and contour of the large intestine. It is rather curious that so few have made use of this procedure in the study of tuberculous colitis. So far as we are aware, the first to call attention in American literature to hypermotility of the cecum was Pirie, who, after carrying out work suggested by Archibald, wrote a paragraph in the article by Archibald already referred to. He states that in tuberculosis of the cecum he was never able to visualize the barium meal in the cecum and was greatly disappointed. By careful observations repeated at half hour intervals and continued for from four to twelve hours, he was able to show that the tuberculous cecum retained none of the barium meal which normally should have accumulated there. He

TABLE 1.—POSITIVE CASES*

Case	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
							Il	Ce	HF	TC	DC	R	Spasm	C	HF	TC	DC	R		
4909	FA	3	+	33	.....	Fav.	+	Sl	..	..	..	..	Ce	o	o	o	+	+	.....	2, 5, 7
5045	FA	3	+	40	.....	Fav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	Ce-HF	7
6867	FA	..	+	60	.....	Fav.	o	Sl	+	+	+	..	Ce	†	..	..	..	..	o	
7162	I	2	o	3	.....	Unfav.	o	Sl	+	+	+	..	Ce	Sl	Sl	Sl*	Sl	Sl	.....	3, 5, 6, 7, 8
7348	FA	3	+	30	.....	Unfav.	+	..	..	..	..	..	.....	o	o	o	Sl	Sl	.....	2 and 5 questionable 7 and 8 persistent
7366	FA	..	+	36	Nephritis	Unfav.	+	Sl	..	..	..	..	Ce	†	..	..	..	..	.....	2, 3, 5, 7, 8 persistent
7541	FA	..	+	14	.....	Unfav.	+	Sl	+	+	+	..	Ce	o	o	o	Sl	+	.....	3 severe, 7
7521	MA	3	+	24	.....	Fav.	+	Sl	+	+	+	..	Ce	o	o	o	o	o	Ce?	1, 3, 6
7541	FA	..	+	8	.....	Unfav.	+	+	o	+	+	..	HF	o	o	o	o	Sl	.....	1, 3, 4, 6, 7
7561	MA	..	–	12	Larynx	Unfav.	+	Sl	+	+	+	..	Ce	o	o	o	o	o	o	1 persistent
7607	FA	..	+	13	.....	Unfav.	Sl	+	o	o	o	+	Ce-TC	o	o	o	o	+	.....	1, 4
7724	FA	..	+	6	Elbow	Unfav.	+	+	+	o	o	+	TC	o	o	o	o	o	o	1 and 7 persistent, 5, 8
7739	MA	3	+	10	.....	Fav.	+	?	..	..	..	..	Ce ?	o	o	o	o	+	o	1 and 6 alternately
7805	MA	..	+	14	.....	Unfav.	+	Sl	o	o	o	Sl	Ce	o	o	o	o	+	.....	1 and 6 alternately, 2, 3, 4, 5, 8
7806	I	3	+	24	.....	Fav.	+	+	o	o	+	..	Ce	o	Sl	o	o	+	o	1, 4, 7
7822	MA	..	o	18	.....	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	+	+	Ce	1, 2, 5, –3 severe
7875	FA	..	+	9	.....	Unfav.	+	..	..	..	..	..	.....	o	o	o	o	o	.....	1, 3
7901	FA	3	+	36	.....	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	Ce	1
5075	MA	2	+	9	.....	Fav.	+	+	+	+	+	..	Ce	Sl	Sl	o	o	Sl	Ce	1
8544	FA	3	+	6	Larynx	Unfav.	..	..	..	..	..	..	.....	o‡	o	o	o	+	Ce ?	6, 7
8593	MA	3	o	12	.....	Unfav.	+	+	..	..	..	..	Ce	+	+	o	o	+	.....	1, 3, 8, –7 severe
8873	I	3	o	14	Appendectomy	Fav.	+	+	Sl	Sl	+	..	Ce	o	o	o	o	+	Ce ?	1, 2, 3, 7, 8
7093	FA	3	+	36	.....	Fav.	+	+	+	+	+	..	Ce-TC	o	o	o	o	..	Ce-TC	1 and 6 alternately
7733	FA	3	+	36	Larynx, ear, rectal abscess	Unfav.	+	Sl	..	..	..	..	Ce	o	o	o	o	o	.....	1, 3, 4, 8
8985	MA	..	+	12	.....	Fav.	+	..	..	..	..	..	Ce	Sl	+	..	..	..	.....	3, 6, 8
5058	MA	3	+	10	.....	Fav.	+	+	+	+	+	..	Ce	o	o	o	o	o	Ce	1, 2, 3, 4, 8
9307	FA	3	+	..	.....	Fav.	+	o	+	o	+	+	Ce	o	o	o	o	o	.....	1, 4, –7 marked
5096	FA	3	+	7	.....	Fav.	o	o	o	o	+	+	.....	o	o	o	o	o	Ce ?	1, 2, 4, 8
4876	FA	3	+	5½	.....	Fav.	+	+	+	+	..	..	Ce	Sl	+	+	+	+	.....	4, 7
9508	FA	3	+	..	.....	Fav.	+	Sl	o	Sl	Sl	+	Ce-HF	o	o	o	o	o	.....	1, 2, 3, 5, 7

* Key to Characters, Numbers and Abbreviations: Pulmonary condition: N, negative; D, doubtful; I, incipient; MA, moderately advanced; FA, far advanced. Roentgen classification: Pb, peribronchial; 1, an area of parenchymatous infiltration including to the superior margin of the first chondrosternal junction on one or both sides, or, to the superior margin of the second chondrosternal junction on one side; 2, greater than 1; an area of parenchymatous infiltration including to the superior margin of the second chondrosternal junction on one or both sides or, to the superior margin of the third chondrosternal junction on one or both sides, or, to the superior margin of the third chondrosternal junction on one side; 3 includes anything greater than 2. Tubercle bacilli: +, positive; o, negative; blanks, no records. Six and 24 hour examinations: Il, ileum; Ce, cecum; HF, hepatic flexure; TC, transverse colon; DC, descending colon; R, rectum; Sl, slight; +, barium present; o, barium has passed this site; the blank spaces indicate the head of the barium column has not reached these sites. Abdominal symptoms: 1, diarrhea: 2, nausea; 3, pain; 4, indigestion; 5, vomiting; 6, constipation; 7, nervousness; 8, gas.

† No examination.

‡ Twelve hour examination.

§ Eighteen hour examination.

based his conclusions on a study of about twelve of Archibald's twenty-seven cases.

It was quite natural that we should have undertaken the study of this method of early diagnosis, as so many suspicious cases came under our observation. After our work was nearly completed, we discovered that in 1911 Stierlin[1] of Basel studied six such cases, in which later operation was done by Wilms. In these cases the absence of barium or bismuth shadows at certain times in certain sites, when normally they should have been present, suggested hypermotility. Stierlin diagnosed on this fact the presence of ulceration of the large bowel at the site which threw no shadow. In six such cases of tuberculous colitis and in one of chronic nontuberculous ulceration, Stierlin's diagnosis was confirmed at operation.

Several years ago, it occurred to us that the only treatment of tuberculous enteritis that promised much relief, or even suggested the possibility of cure, was surgical intervention,

TABLE 2.—NEGATIVE CASES

Case	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
							Il	Ce	HF	TC	DC	R	Spasm	Ce	HF	TC	DC	R		
4716	MA	I	+	18	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	4
4743	MA	Pb	+	21	.....	Unfav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	2, 5, 6, 7, 8
4768	MA	I	0	13	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	..	.....	2, 4, 5, 6, 7
4773	MA	I	–	8½	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	2, 4, 6, 7
4774	MA	Pb	–	48	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	2, 5, 6, 7
4777	MA	Pb	+	42	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	1, 3, 4
4785	MA	Pb	–	8	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	6
4787	D	Pb	0	18	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	1, 2, 4, 5, 7
4803	MA	I	–	10	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	4, 6
4810	MA	2	+	12	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	4, 6
4814	D	Pb	0	24	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+		.....	
4817	D	Pb	0	36	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	4
4818	MA	I	0	9	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2, 4, 6
4783	MA	2	+	8	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	2, 4, 5
4824	I	Pb	0	24	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	..	.....	4, 6
4827	MA	3	+	6	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2
4829	D	Pb	0	6	.....	Fav.	+	..	..	..	..	..	0	+	+	+	+	+	.....	2, 4, 6, 7
4839	MA	2	+	16	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	4, 6
4846	MA	2	+	27	.....	Fav.	+	+	+	+	..	..	0	+	+	..	..	..	.....	2, 3, 5, 8
4852	MA	I	0	14	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	2, 4, 5, 6
4878	MA	I	+	5½	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	6
4887	MA	Pb	0	4	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2, 4, 6
4894	D	Pb	0	16	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2, 4, 5, 6
4905	N	Pb	0	65	.....	Fav.	+	+	+	+	+	..	0	+	+	+	+	+	.....	4
4895	MA	3	+	6	.....	Unfav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2, 5, 6
4907	MA	I	0	72	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2, 4, 5, 6, 7
4916	MA	Pb	–	6½	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+		
4920	MA	2	+	30	.....	Fav.	+	+	+	..	..	..	0	+	+	+	..	..	.....	4, 6, 8
4921	N	Pb	0	18	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	2, 6, 7
4922	MA	2	0	20	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+		
4940	MA	I	0	10	.....	Fav.	+	+	+	..	..	..	0	+	+	..	..	..	.....	2, 4, 6
4942a	MA	2	+	19	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	4, 6
4943	MA	2	+	4	.....	Unfav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	2, 4
4953	MA	3	+	14	.....	Fav.	+	+	+	..	..	..	0	Sl	Sl	+	0	+		
4978	MA	I	0	120	Addison ?	Unfav.	+	+	+	..	..	..	0	+	+	+	..	..	.....	2, 4, 6
4998	MA	2	+	4	.....	Fav.	Sl	+	+	+	..	..	0	+	+	0	0	+	.....	2, 3, 4, 5, 6
5007	MA	3	+	72	.....	Fav.	+	+	+	+	..	..	0	Sl	Sl	+	+	..	.....	4, 7
5024	I	Pb	0	72	.....	Fav.	+	+	+	+	..	..	0	+	+	+	0	0		
5042	MA	I	0	96	.....	Fav.	+	+	+	..	..	..	0	+	+	+	..	..	.....	2, 4, 6, 7
5080	I	I	+	12	.....	Unfav.	+	+	+	..	..	..	0	0	+	+	+			
7505	D	Pb	NS	48	.....	Fav.	Sl	+	+	..	..	..	0	Sl	+	+	0	0	.....	3, 6
7681	MA	2	+	11	.....	Fav.	+	+	+	..	..	..	0	+	+	+	+	+		
7770	N	?	0	1	.....	Fav.	Sl	+	+	Sl	Sl	..	0	Sl	+	Sl	0	+	.....	3
7977	I	2	NS	6	Epidid. ?	Fav.	+	+	+	..	..	..	0	+	+	+	+	+	.....	3
5037	MA	2	0	6	.....	Fav.	+	+	+	..	..	..	0	+	+	+	0	+	.....	2, 4, 5, 7
8526	I	2	0	14	.....	Fav.	+	+	+	+	..	..	0	+	+	+	0	+	.....	8
8551	MA	2	I	22	.....	Fav.	..	..	..	..	..	..	.....	+§	+	+	+	+	0	I
8559	MA	2	+	42	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	0	3
8792	MA	I	+	8	.....	Fav.	+	+	+	..	..	..	0	+	+	0	0	+	.....	8
8913	MA	2	+	18	.....	Unfav.	+	+	+	+	+	Sl	0	..	..	..	..	..	.....	2, 5, 6
9088	MA	2	+	156	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	1, 4
9207	I	..	0	60	.....	Unfav.	+	+	+	..	..	..	0	+	+	+	0	Sl	.....	8
9192	MA	3	+	6	.....	Fav.	+	+	+	..	..	..	0	+	+	+	Sl	..	.....	8
9141	I	..	+	96	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	1, 2, 3, 8
9106	MA	..	+	120	.....	Fav.	+	+	+	+	+	..	0	+	+	+	+	+	.....	4, 7
9105	MA	2	..	120	Effusion	.....	+	+	+	+	..	..	0	Sl	Sl	0	0	+	.....	1, 2, 3
4822	MA	I	+	5½	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+		
5065	MA	2	+	18	.....	.....	+	+	+	..	..	..	0	+	+	+	+	+	.....	4
9227	MA	2	+	84	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	4, 8
9228	MA	2	+	24	.....	Fav.	+	+	+	+	..	..	0	+	+	+	+	+	.....	4, 6

TABLE 3.—DOUBTFUL CASES

Case	Pulmonary Condition	Roentgen Classification	Tubercle Bacilli	Duration of Illness in Months	Tuberculous Complications	General Condition	Six Hour Examination Barium Shadows							Twenty-Four Hour Examination Barium Shadows					Filling Defect Enema Plate	Abdominal Symptoms
							Il	Ce	HF	TC	DC	R	Spasm	Ce	HF	TC	DC	R		
4775	MA	3	+	30	.....	Fav.	+	+	+	..	..	..	.....	o	o	o	o	+	.....	1, 2, 3, 4, 5
4780	MA	3	+	54	.....	Fav.	+	+	+	..	..	..	.....	o	o	o	o	o	.....	6
4815	I	1	o	42	.....	Fav.	+	+	+	+	..	..	Ce ?	o	o	o	+	+	.....	4, 7
4881	MA	3	+	30	.....	Fav.	+	+	+	..	..	..	.....	+	+	+	+	+	Cecum	2, 3, 4, 6, 8
4902	MA	2	+	3	.....	Fav.	+	+	+	+	..	..	Ce ?	Sl	Sl	Sl	Sl	+	.....	2, 4, 5, 7
4908	MA	2	o	7	.....	Fav.	+	+	+	+	+	+	.....	o	o	o	+	+	.....	2, 3, 4
4948	MA	Pb	o	36	.....	Unfav.	+	+	+	..	..	..	.....	o	o	o	o	+	.....	2, 4
4955	MA	2	+	2	.....	Fav.	+	+	..	..	..	..	.....	o	o	o	o	+	.....	4, 6
5000	MA	3	+	24	.....	Fav.	+	+	+	+	..	..	.....	o	o	o	o	+	.....	4, 6, 7
7522	FA	..	+	36	Larynx	Unfav.	+	+	+	+	..	..	Ce ?	o	o	o	Sl	+	.....	1 and 6 alternately
7529	FA	3	..	60	Appendectomy	Unfav.	+	Sl	Sl	..	..	..	Ce ?	Sl	o	o	+	+	.....	1, 3, 4, 7, 8
7722	MA	3	+	18	Larynx	Fav.	+	+	+	+	..	..	.....	o	o	+	o	+	o	1
7863	MA	..	+	24	Larynx	Fav.	+	Sl	o	o	+	..	.....	+	+	+	o	Sl		
7877	FA	3	+	9	Larynx	Unfav.	+	..	..	..	..	..	.....	+	+	+	..	..	..	.....
8563	MA	3	+	42	.....	Fav.	..	..	..	..	..	..	Ce ?	+‡	+	+	o	+	o	1
4544	MA	Pb	+	10	Larynx	Fav.	o	+	+	+	..	..	Ce ?	Sl	+	+	+	+	.....	1, 3, 4
8942	MA	3	+	12	Otitis media	.....	+	+	+	+	Sl	..	.....	o	o	+	o	Sl	.....	8
9206	MA	3	+	18	.....	Fav.	+	+	+	+	..	..	Ce ?	o	+	+	+	o	.....	6, 8
9135	FA	3	o	12	.....	Unfav.	+	+	+	..	..	..	Ce ?	+	+	+	+	o	.....	3, 6
7493	FA	3	+	20	Larynx	Unfav.	+	Sl	..	..	..	..	.....	Sl	Sl	o	Sl	Sl	.....	2, 3, 8, 1 and 6 alternately
7923	MA	3	+	48	Nephritis	Unfav.	+	+	+	+	+	..	.....	Sl	+	+	o	o	Cecum	1, 3, 7,—8 marked

which led us eventually to discuss the subject with Archibald. For this reason, and because we have had an opportunity of seeing clinically and of studying roentgenographically some of the cases in which later operation was done by Archibald and by R. M. Brown, our interest in the subject has increased; especially is this true since we have been impressed with how little general medical practitioners and, for that matter, even specialists in tuberculosis, gastro-enterology, and roentgenology, know of the technic necessary to make a diagnosis of tuberculosis of the large intestine.

TECHNIC

The technic varies little from that used in most roentgen laboratories. The day before the examination the patient is requested to abstain from taking any laxative. At an appointed hour the next morning he is given a barium suspension on an empty stomach (formula: 1 tablespoonful of cocoa, 1 tablespoonful of sugar, 1 tablespoonful of flour, 4 ounces of barium, and milk to make 16 ounces). The examination during the ingestion of the meal has often been omitted, on account of the patient's condition. However, it is not usually of any importance in this work. Six hours after taking the meal, the patient is examined fluoroscopically and roentgenographically. This examination is important, as at this hour one should visualize the cecum and probably the ascending colon. An examination every half hour for the next hour or two may be necessary in order to catch the cecum partially or wholly filled. When possible, the patient is examined at the end of eighteen hours, but always at twenty-four hours. The eighteen hour examination may make the twenty-four examination unnecessary. Plates are absolutely necessary at all examinations. A day or two later, the patient, having taken an ounce of castor oil eighteen hours before, returns for a barium enema. The enema is administered by low gravity pressure, from 10 to 12 inches, and the injection is observed fluoroscopically. When the enema is seen to have reached the cecum or, as in many cases, has passed through the ileocecal valve, it is stopped and a plate is made in the prone position.

NORMAL MOTILITY

For convenience, we may say that the normal stomach empties itself in from three to six hours. The head of the barium meal reaches the ileocecal valve in from one to three hours. The ileum empties itself in from five to nine hours. The cecum is seen in from two to four hours after the ingestion of a meal. Six hours after the meal has been taken, the head of the column is seen at the hepatic flexure or the

splenic flexure. Complete evacuation of the meal takes place in from thirty-six to forty-eight hours. The cecum remains well or partially filled from the fourth to the thirty-sixth hour.

PATHOLOGIC HYPERMOTILITY

The first rather marked variation in the foregoing order of things to attract our attention was the rapidity with which the barium passed through the large bowel. Complete evacuation often occurred in from twenty to twenty-four hours, although it is not unusual, in a certain number of cases, to find a small amount of barium still in the rectum at the end of this interval. In many cases (usually the more positive), in six hours the head of the column could be seen in the sigmoid and rectum, while at the same time there was a small retention in the stomach. In view of the fact that the patients manifesting this hypermotility had not taken any cathartic for thirty-six hours prior to the examination, this rapid progress through the large bowel needed explanation. On closer observation, it was noticed in many of the cases that apparently the cecum or cecocolon was the seat of this definite hypermotility. A typical illustration is Case 7875. The six hour examination gave no trace of barium beyond the ileocecal valve; the terminal ileum was well filled. The nine hour examination disclosed faint traces of barium in the cecum and a fair amount around the hepatic flexure. This case would seem to indicate that the cecum and cecocolon refused to retain the material delivered to it and passed it along about as rapidly as it was received. In none of the cases later proved at operation to be tuberculous were we able to visualize a well-filled cecum or cecocolon, with the usual smooth haustral sacculations. It appeared as though the ulcerated portion of the bowel was unable to retain the usual amount of barium; or, indeed, it seemed to be completely emptied. In many of the positive and probable cases there was noticed a definite ileac stasis[2] at six hours with hypermotility in the cecum at subsequent examinations. Whether this apparent stasis was due to stricture, to spasm of the sphincter or to regurgitation, it is difficult to say. The last would seem to be very likely in many of the cases.

The question arose immediately: Could conditions other than ulceration of the cecum or of the ascending colon produce this rapid type of hypermotility with its peculiar attending features? A few control cases were examined after the administration of a cathartic (castor oil), and while there was an increase in rapidity of the passage of feces through the large bowel, the bowel did not present the same manifestations as are seen in those patients proved to have had tuberculous colitis. The former cases showed smooth haustration, and, while the contents moved along more rapidly than they did when not under the influence of the cathartic, a spastic or ragged contour was never visualized.

A few cases of acute or habitual diarrhea produced about the same manifestations as were observed in those in which cathartics were given. A study of an article by Jordan,[3] in which he illustrates a number of cases of colitis and diarrhea, fails to reveal any indication of the hypermotility observed in tuberculous colitis. From a study of the prints in articles by Imboden[4] and Spriggs,[5] it seems possible to exclude definitely disease of the appendix as the cause of these manifestations. George and Leonard,[6] in their book, apparently make no mention of such a picture as due to any other cause.

FILLING DEFECTS

The second, and probably the more important, manifestation observed was the spastic appearance of that portion of the bowel later proved to be involved, usually the cecum or cecocolon. The smooth haustral sacculations were absent and the bowel had a distinctly irregular and ragged appearance. In the positive cases the affected portions of the bowel were only partially filled. Under the fluoroscope, barium was seen to enter the diseased cecum; but a few minutes later it had passed on to the transverse colon. In some cases, while the abdomen was being palpated in the region of the ascending colon, the barium shadows were seen to move out of this portion of the bowel, even though no more barium had entered it, and *vis a tergo* could apparently be excluded. We have not been able to reproduce this particular manifestation in patients having apparently no tuberculous colitis.

STUDY OF BARIUM ENEMAS

In many of the cases we were unable to administer barium enemas, owing to the weakness of the patients, who, however, had usually a positive diagnosis. With the administration of the enema, in some cases, the barium was seen to move slowly, as a smooth mass, until it reached the suspected portion of the bowel, where it stopped. It was usually necessary to increase the gravity pressure in order to fill, in part, this portion of the bowel, which at times showed here and there irregular, string-like barium shadows, extending from the main column of barium into the portion of bowel we were attempting to fill. These manifestations suggested that the suspected portion of the bowel was in a state of spasm or collapse, and refused to receive the barium enema. By manipulation, however, it could usually be filled fairly well. In many cases, nevertheless, the filling was only temporary, for this portion of the bowel apparently developed a contraction or spasm, and the barium column was seen to move distally rather rapidly. In a few instances the ascending and transverse portions of the colon were emptied completely, producing a dilatation of the distal colon. The plates taken at this time which were considered to give positive evidence showed a definite filling defect in one or more portions of the bowel, usually the cecum or the cecocolon. So far, we have been unable to discover any condition, apart from intestinal ulceration, which produced this picture.

ANALYSIS OF RESULTS

In all, examinations were made in 110 cases. Three cases (2.7 per cent) were negative for pulmonary tuberculosis; six cases (5.4 per cent) presented only suspected pulmonary tuberculosis; eleven cases (10 per cent) exhibited incipient pulmonary tuberculosis; in sixty-eight cases moderately advanced pulmonary tuberculosis was present, and in twenty-two cases pulmonary tuberculosis was far advanced.

Among the negative and suspected or doubtful pulmonary cases there was no roentgenologic evidence of tuberculous colitis. In these groups, however, there were a few cases which showed a mild hypermotility.

Of the eleven incipient pulmonary cases, seven were negative; one gave doubtful roentgen findings; three gave positive findings. Of the last three cases, one was proved at operation; one patient died of pulmonary and intestinal tuberculosis(?); one patient is alive, and has not been operated on.

Of the sixty-eight moderately advanced pulmonary cases, forty-four were negative; fifteen, doubtful, and nine, positive. Of these nine, four were proved at operation, and five patients were not operated on.

Of the twenty-two far advanced pulmonary cases, none were negative; five were doubtful. Of these five, three patients were not operated on, and two are dead. Seventeen were positive. Of these seventeen nine were verified at operation; three ended with death; five patients were not operated on.

In many of the foregoing cases the operative findings tallied very closely with the diagnosis as to site and extent. The remainder, however, revealed more extensive ulceration than the plates or screen indicated. This can be readily explained by the fact that the barium remained such a short time in the diseased areas, particularly in the transverse and descending colon, that it was mere guesswork when these portions of the bowel were under consideration to confirm or exclude tuberculous changes. Then again, the motility of this part of the bowel would in all probability have to be studied at different hours. The lack of haustration would depend largely on the character and quantity of the barium visualized.

Through the kindness of Drs. Robert M. Brown, R. C. Paterson, S. F. Blanchet and Charles C. Trembley, we have been enabled to study roentgenographically some of their cases. It is interesting to note that in this second set of similar cases, the results were identical with those mentioned above.

We have intentionally omitted from this article any mention of the diagnosis of tuberculosis of the small intestine. So far as we are aware, no one has yet been able to diagnose definitely tuberculosis of the small intestine. This should always be borne in mind in suggesting operative measures. We have at present the problem under study and hope to arrive at its solution.

A number of cases classified as doubtful, which presented, on clinical study, all the typical symptoms of intestinal tuberculosis, revealed at the roentgen examination a fairly marked tendency toward hypermotility, which

was not sufficient, however, to enable us to regard it as a positive finding. Further, the cecum at the six hour examination (which usually extended over a period of at least fifteen to thirty minutes) never assumed its normal pouchlike appearance, but appeared more or less narrowed, or was distinctly incompletely filled, even though barium was seen distal to this site. The diameter of this portion of the bowel was apparently less than the diameter of the ascending and transverse portion. Normally, it may be recalled, the cecum is larger in diameter than any portion of the colon with the exception of the sigmoid and rectum. Furthermore, fluoroscopic examinations were necessary to confirm these data. The outline, while not typically ragged, did not reveal the smooth haustral sacculations normally seen. Finally, we would like to call attention to the fact that some of these cases were put in the doubtful group because we thought the plate might have been taken at a time when the characteristic appearance of the cecum was not present. Had we waited, a few minutes later we might have observed this portion of the bowel virtually empty. The enema plate, as a rule, with the possible exception that the cecal shadow was definitely narrower than the ascending colon, revealed no abnormalities. In a few of these cases operation has been done and they have been found tuberculous. Further, we would not like to assert that the absence of detectable hypermotility and filling defects absolutely excludes the possibility of tuberculous colitis. The presence of a beginning hypertrophic colonic tuberculosis may cause not only lack of emptying but even cecal retention at the end of twenty-four hours.

CONCLUSIONS

1. Tuberculous colitis can be diagnosed clinically with a considerable degree of certainty when the disease is far advanced.

2. On the other hand, in the early or latent stages, when remedial measures may prove of avail, the clinical picture may be of little aid in diagnosis.

3. In all stages, certain shadows cast by the barium meal at the end of six, eighteen and twenty-four hours determine definitely the presence of colonic ulcerations, but the absence of such shadows does not absolutely exclude colonic ulcerations.

4. The roentgenologic picture shows hypermotility and spasm, or filling defects.

5. The presence of such a picture in a patient with pulmonary tuberculosis should lead to a definite diagnosis of colonic tuberculosis.

6. Tuberculous colitis occurs far more frequently than hitherto supposed, and must be excluded in all advanced cases and in any early case with any abdominal symptoms, before submitting the case to radical treatment.

7. No examination of a patient with pulmonary tuberculosis can be considered today complete without a roentgenologic study of the intestine.

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2. We considered ileac stasis present if, at the six hour examination, the following was observed: stomach seven-eighths or completely empty, ileum well filled, no barium having reached the cecum.
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4. IMBODEN: Am. J. Roentgenol. 2: 582, 1915.
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CONSTANTIN, VIGOT and GOSSELIN. Immobility of the Cardio-Pericardial Shadow Considered as a Pathognomonic Sign of a Lesion of the Heart. (*J. de radiol. et d'électrol.*, Paris. February, 1918.)

The signs of wounds of the heart are of great variety, thus explaining the numerous errors of diagnosis and tardy or useless interventions. Fluoroscopy is of the utmost help in determining the necessity of intervention. The authors had under observation three cases of wounds of the heart (by small pieces of shell), complicated with hemopericardium, the effusion of blood being every time demonstrated by fluoroscopic examination.

The fluoroscopic signs of pericardial effusion are:

I. Augmentation of all diameters of the shadow of the heart.
II. Changes in the outline of this shadow.
III. A more or less complete disappearance of the rhythmic movements.

In cases of serous or purulent pericardial effusion the outline of the shadow of the heart is sometimes pulsatile.

The increase of the shadow may be due to a cardiac dilatation and is not a pathognomonic sign.

The deformation of the outline of the shadow of the heart has not a great value, as a wound of the lung may blur and change this outline.

The immobility of the outline of the shadow of the heart is a sign of first importance and its presence gives a certitude of a lesion of the heart. In two of the cases observed by the authors, the immobility was absolute, giving the impression, that "the heart had ceased beating." In the third case, there was a very slight undulation of the left border of the shadow, at the level of the left ventricle.

BÖDLER, LORENZ. A Case of Congenital Permanent Dislocation of the Patella. (*Ztschr. f. Orthop. Chir.*, Stuttg., 1918.)

A man, forty years of age, presented himself for rheumatic pain in the left lower limb, which from childhood was always weaker than the right. He started walking only at the age of six with the aid of a cane, which he discarded at nine. He could never keep pace with his fellows, his left leg tiring very quickly. Going down he has no difficulty, but stepping up requires effort and exhausts him. The left thigh is atrophied. The calves are about equal in size.

The site of the patella shows itself dislocated to the left during extension and flexion. The roentgen ray shows in the anteroposterior plate that the patella rests on the outer side of the left external condyle, almost sagittally, that is with a torsion of 90°. On the lateral plate the patella cannot be seen. When the knee is flexed, the patella slides so far back that it is completely covered by the head of the fibula.

In the extreme flexion an anteroposterior plate shows both condyles normally developed, the patella at 45° from the outer surface of the external condyle, just above the head of the fibula. Instead of its being almost parallel with the tuberosity of the tibia, it lies at an angle of 70°.

DOUGLAS. Carcinoma of the Stomach. (*Surg., Gynec. and Obst.*, 1919, XXVIII, 76. Ref. *Progress Med. Sci.*, p. 848.)

The conclusion reached by the pathologists of the Mayo Clinic, where probably more material from excisions of ulcers and early carcinomata are examined with the greatest care than anywhere else in the world, should carry great conviction, even considering the work of Bullock. The considerable but not tabulated reports in cancer in a small area of the edge of an old ulcer, is proof positive that the change does occur, confirming the above statement. The evidence that cancer develops from chronic irritation and ulcers in other localities, adds probability that the same metamorphosis occurs in the stomach. The agreement of those who are opposed to the theory of carcinomatous degeneration in a large percentage of ulcers that a previous ulcer history may be obtained in from 5 to 17 per cent together with the facts that diagnosis is not always certain, and that ulcers may perforate without previous symptoms, and that a long ulcer history is not contrary proof, would seem at least to make it a fair presumption that ulcer preceded cancer in a larger percentage of cases than their figures indicated. The results after gastro-enterostomy are the strongest presumptive evidence against carcinomatous degeneration of ulcers, but an explanation is not inconceivable, based on the rapid healing which usually occurs in ulcers near the pylorus after operation, and the theory of a possible inhibition of cancer formation after gastro-enterostomy, according to the theory of Gressot, on the possible digestion of sloughing carcinoma, and remembering the claim that a large percentage of cancers originate in ulcers does not mean that a large percentage of ulcers necessarily become malignant. The following facts are not contested: (1) The mortality without operation is 100 per cent; (2) the percentage of deaths from cancers of the stomach in the total death-rate is 1 per cent. (3) More than 30 per cent of all cancers occur in the stomach. (4) Of late years the statistics at the large clinics show an operability of 38 (Mayo) to 39 (Bloodgood) per cent of cases coming to the surgeon. Gastric ulcers are potentially cancer and a diagnosis macroscopically in the early stage of malignant development cannot be made; therefore, an old callous ulcer in a patient of the cancer age should, when possible, be excised. If small and not believed to be malignant, and only then, it may be destroyed by the cautery method, and a gastro-enterostomy done, or else a transgastric resection or pylorectomy performed

whenever it seems even possible that carcinoma has begun at any point in the margin of the ulcer.

STRONG. Polypoid Adenoma of the Uterus. (*Am. J. Obst.*, 1919, LXXIX, 502. Ref. *Progress Med. Sci.*, p. 858.)

One of the very frequent forms which tumors of the uterus take is that of polypus and it is not unusual to hear this term used as though it constituted a diagnosis of a condition. It is plain, however, that the word relates merely to external form and tells nothing of the structure and hence nothing of the nature of a tumor. There are a definite number of pathological conditions which may assume this form and these are generally not especially difficult of recognition in the gross specimen, so that it would be more satisfactory to speak of such tumors according to their specific class using the word "polypus" as a qualifying adjective, thus, "myoma polyposum," etc. What are perhaps most commonly meant when polypi of the uterus are spoken of are adenomata, either of the cervix or corpus uteri. These are tumors of common occurrence, but they have received rather scanty attention in text-books and reports, since their importance clinically has been considered to be slight. During the past five years there have occurred at the Woman's Hospital in New York City several cases where such polypoid adenomata have developed into malignancy of a type which appears to have striking individual characteristics. It should be noted that the polypoid form of these tumors is but a mechanical and secondary effect of the special region in which a tumor is produced and that it has no pathological significance in itself although it frequently does have a clinical significance which may be important, such as hemorrhage and necrosis, both due to interruptions in the blood supply. Pathologically, these tumors may be adenomata, myomata, carcinomata or sarcomata, or they may be an evidence of a simple polypoid hyperplasia of the uterine mucosa. Microscopically, the adenoma has in general all the characteristics that the hyperplasia has not, that is, the glands are irregular in size and outline, their cells show irregularities of arrangement and form and the relationships between gland and stroma are widely disturbed. The basal layer has the adenomatous changes as marked as the rest of the mucosa instead of the relatively simple glands of the normal basalis. According to Strong, there is no difficulty in recognizing an outspoken adenoma but the changes which separate it from simple hyperplasia are all relative and not absolute. The reason that uterine adenomata are polypoid is a physical one, namely, that they are surface tumors and represent non-invasive proliferations of simple glands, and the increase in bulk produced by the proliferation, being non-destructive of other tissue, tends to grow in the direction of least resistance, therefore, on a surface, the proliferation is outward.

BOGGS. Radium in Cancer. (*N. Y. M. J.*, 1919, CIX, 488.)

Skepticism in regard to the value of radium in the treatment of malignancy is rapidly disappearing on account of its extensive use and the brilliant results that have been achieved in many cases especially in epithelioma, fibroids and as a palliative measure in inoperable cancer. It is now generally agreed by the surgeons of the largest clinics that radium is a valuable adjunct in the treatment of malignancy. In some places it is used only as a palliative procedure while in other places it is also being used as an anti-operative treatment. In discussing this matter Boggs reminds us that several factors have brought radium into disrepute and have given the impression that the claims made were unjustified. Chief among these is allowing patients and the physicians who refer them to us to expect a permanent cure when only palliation and prolongation of life is all that any one with ordinary medical intelligence could expect. The patient often cannot receive much palliation from any other method of treatment, but by the use of radium will improve rapidly for a time, or even a clinical cure will be obtained. Finally, on account of the extensive metastases, the patient will die after from six months to three years or more of prolongation of life. Then those who were watching the case or those who knew that radium had been used, will decide that radium had no value, without remembering or knowing the condition of the patient when radium was started. If one is to express an opinion as to the therapeutic value of a remedy, such statements should be guarded unless a

study of all factors has been made and one should be without prejudice for or against the remedy. Many operators have used insufficient quantities of radium thus giving inefficient doses, or else, on the other hand, have overtreated the local growth, without attempting to treat the metastases. No one will deny that, under certain circumstances radium may be harmful rather than beneficial, since if the dose is too small or too long continued, stimulation rather than destruction may take place while, on the other hand, too large a dose may result in irreparable damage to normal tissues. Treatment of hopeless carcinoma in the past has been with morphin, but today the author believes that it should be by radiotherapy since it is pitiful that patients with inoperable cancer, after their condition is pronounced hopeless, receive so little consideration. However, he cautions that thorough knowledge of the action of radium is essential because from that knowledge only may the proper dose be applied to produce the best results and haphazard use of radium should be discouraged. In estimating the value of radium therapy, its advocates do not claim that it supersedes surgery, but that it is a valuable adjunct to surgery, in helping to prevent recurrences after operation and in rendering inoperable cases operable and that it has proved itself one of the best palliatives we have in cases in which operation is impracticable and in many of such cases has brought about an apparent cure. In recurrent and inoperable carcinoma of the uterus, Boggs believes that radium might be considered the specific treatment, because it is the only method which retards the process to the same extent and gives the same amount of palliation. Radium is always less valuable in recurrent than in inoperable carcinoma of the uterus and since so much has been accomplished in the inoperable cases, in every primary case, no matter how early the operation has been performed, Boggs believes that there should be either ante- or postoperative treatment with radium, or both.

MANTOUX, CH., and MAINGOT, G. Radioscopic Examination of the Lung and its Limited Sensitiveness. (*Bull. Soc. méd. d. Hôp. de Par.*, October 24, 1918.)

In the immense majority of clinical examinations of the thorax, auscultation and radiologic researches give on the whole quite comparable results.

Nevertheless, in some cases the diagnosis based upon both methods is not comparable. If the lesions are deeply located and separated from the ear by a deep layer of sound pulmonary tissues, they may be detected only by roentgen rays, while on the contrary some lesions perceivable with the ear are invisible with roentgen rays. Such are lesions developing in bronchitis and dry pleuritis and presenting no concomitant inspissating of the pulmonary tissues; lastly there are some tuberculous infiltrating lesions invisible on the radioscopic screen because of insufficient sensitiveness of the method.

Very small lesions are undetected by roentgen rays, as are the very fine details of bone structure. Below a certain extent and a certain thickness, the foci of tuberculosis infiltration are invisible on the screen.

The authors have determined experimentally the conditions of visibility of tuberculous lesions. The tests were undertaken with normal subjects of normal stoutness, and fragments of tuberculous tissues removed at necropsies.

The following results were obtained:

Fragments of tissues, 5 to 7 mm. thick and extending over several cm. square, gave shadows barely visible on the screen, as did also a fragment of infiltrated pleura, 15 mm. thick. A distinct shadow was obtained only with a fragment of ganglion 2 cm. thick.

None of these fragments gave visible shadows if examined through a stout person.

Thus the authors conclude that the nondetection of tuberculous lesions after a radioscopic examination does not prove with certainty that there are no pulmonary lesions or pleural alterations.

MAJOR BOUGOURD, A Speedy and Inexpensive Process for Obtaining Radiographic Reduction on Bromide Paper. (*Bull. de Radiographie Militaire*, February, 1918.)

At the Laboratory of Radiography of the 37th Hospital at Granville a rapid and economical process for obtaining reductions of radiographic plates is used.

In front of a well-lighted window of which the pane has been provided with opaque glass,

a wooden frame meant to receive the intermediaries for the different sizes of the plates is placed.

At the proper distance is a small camera, 13 x 18 centimeters, with rectilinear objective and a focussing plate of ground glass.

After the plate is exposed on the window in its intermediary, the surface protected by black paper masks, the focus is taken according to the size of proofs required. It is rather better to use the diaphragm to get a greater accuracy of details, then the ground-glass plates are replaced by a masked frame holding, instead of sensitive plates, a sheet of rapid bromide paper protected by a glass plate to avoid creasing.

The time of exposure varies according to the intensity of the daylight or the strength of the plate, generally ten seconds for a normal photograph. It only remains to develop carefully. To avoid any blurring it is wise to mask the rest of the window with curtains or blinds.

This speedy and inexpensive process gives very clear reductions, and the quantity of bromide paper used is very small, sizes being 9 x 12, or 8 x 10 centimeters.

The reduced proofs can be added to the papers of a case, and will take the place of encumbering drawings or larger photographs.

They can also be used for collections in albums of small dimensions.

KIMURA. Effect of *X*-rays on Carcinoma in Vitro. (*J. Cancer Research*, 1919, IV, 95.)

Some experimental work with mouse tumors has been performed to determine the effects of roentgen ray irradiation on living carcinoma and sarcoma cells in tissue cultures *in vitro*. In the course of the research, it was found that mouse carcinoma and sarcoma grow as well in guinea-pig plasma to which has been added mouse serum diluted with Ringer's solution as in mouse plasma itself, and the outspreading growth of cells in culture, both sarcoma and carcinoma, was not stopped by roentgen ray action varying from E 4 to E 12. The mitotic figures of cells were limited to a minimum after an exposure of E 8; after exposure to E 12, however, they disappeared entirely and the treated tissue produced no tumor when inoculated into mice. The growing power of sarcoma after E 4 exposure was stimulated to some extent, while carcinoma was not appreciably influenced. After an exposure of tissues to E 12, both sarcoma and carcinoma, the growing power of these tissues was stopped when inoculated into mice, and eliminated the process of mitotic division of cells. The process of oxidation of tissues, both sarcoma and carcinoma, was stimulated by the roentgen ray action of E 4 and retarded by exposure to E 12 of the ray. The terms E 4, E 8, E 12 indicate that the Hampson's pastille used No. 8 or No. 12 tint, that is, equivalent to a dose ¼, ½, or ¾ of Sabouraud's B tint.

HOLWEG, H. The Combined Roentgen and Benzol Treatment of Leukemia (Zur kombinierten Behandlung der Leukamie mit Roentgenbehandlung und Benzol). (*München Med. Wochenschr.*, 1918, LXV., No. 44.)

So far, all attempts to cure leukemia either with roentgen rays or with benzol alone have failed. Neumann treated a case with benzol in which the number of leukocytes fell from 56000 to 5300 and the enlarged spleen was reduced to one-half of its original size. Though the administration of benzol was then stopped, the number of leukocytes went on diminishing until it reached 200 per c.c. After 39 days the patient died, but not of leukemia, but of benzol poisoning. Benzol must therefore be administered with caution.

The author applied combined roentgen and benzol treatment to a patient 55 years old. Splenic dimensions 28 x 12 cm. Hemoglobin 60 per cent. Red cells 3,340,000. White cells 148,750. Treatment: First once, then three and four times daily, of two capsules (.5 g. benzol and .5 g. olive oil) and roentgen treatment once a week. (25 minutes, 3 mm. aluminum filter, distance 30 cm., dose each time 5 Holzknecht). Treatment began Oct. 27, and continued four months. March 4, examination of blood: Hemoglobin 82 per cent; red cells 3,968,000; white cells 62000. Benzol was stopped December 22, when white cells had fallen to 37,100. Roentgen treatment was stopped January 3, when the spleen had reached the dimensions of 12 x 7 cm. At present the case is apparently cured.

OPITZ, E. On Highly Filtered Roentgen and and Radium Rays (Ueber stark gefilterte Roentgen und Radiumstrahlen). (*Med. Klinik*, Berlin, 1918, XIV, No. 38.)

The alleged danger of filtered roentgen rays has lately played a considerable rôle in medical literature. Cases of injuries to the intestines ending in death have been reported. These reports led Opitz to study this question more closely. Measured quantities of roentgen rays may produce irritation and tissue changes: 1. The biological effects of the rays depend on the quantity of the roentgen rays absorbed by the tissues. 2. It is within wide limits independent of the hardness of the rays. 3. The effect is greater if the dose is given at one sitting than if subdivided. 4. The effect of the same dose is greater if given with high intensity for a short time than if administered with low intensity for a long time.

The conditions which, in the deep application of the roentgen rays, produce the least injuries to the body with a favorable effect are as follows: 1. Great hardness of the rays (qualitative homogeneity). 2. Spacial homogeneity. 3. The largest possible field. 4. The smallest possible area of the exposed tissue mass. 5. Highest possible intensity. 6. Administration of rays at one sitting if possible. 7. Avoidance of ray crossing in superficial layers when several fields are treated. It is impossible to combine all these conditions as some of them interfere with each other. A medium procedure must therefore be adopted. The following has proved the most favorable: Focal distance from the skin, 50 cm.; size of field 15 x 15 cm., filtration by 1 mm. copper plate (in lean patients ½ mm. copper or 10 mm. aluminum). Administration of full dose at one sitting.

As a prerequisite for the application of hard-filtered rays it is necessary to know how much radiation is used. A proper measuring method must be applied. But so far only gauged iontoquantimeter chambers can be relied upon. Sabouraud pastils, intensimeters, etc., are of little value.

HAUDEK, M. Contribution to the Pathogenesis and Diagnosis of Gastric and Duodenal Ulcer (Ein Beitrag zur Pathogenese und Diagnose der Magen—und Zwölffingerdarmgeschwüre). (*München. Med. Wochenschr*, 1918, LXV, No. 32.)

An analysis of the roentgenological phenomena observed in gastric and duodenal ulcer leads the author to the following results: 1. In the early stages of all primary roentgen phenomena we meet with motor and secretory irritation phenomena which occur also without ulcer in purely nervous disturbances, so that the differential diagnosis is difficult and the question whether these irritation phenomena are produced reflexly by the ulcer or must be considered as primarily neurogenous, is undecided. 2. The stomach reacts to the induced irritation always with an increased contraction. The kind of reaction, or the form of the increased contraction, depends on the primary form of the stomach. The knowledge that the roentgenological ulcer symptoms are to a certain extent resultant phenomena from a disturbance in the vegetative nervous system, admonishes us to enlarge our limited knowledge in the field of pathology, especially of pathological histology. It will then perhaps be possible to replace the terms "nervous disposition," "neurosis," etc., by the names of well-defined diseases of the vegetative nervous system (centres or tracts, vagus and sympathetic nerve), or of the nerve endings, which manifest themselves primarily by irritation phenomena (stomach, intestines, heart, etc.).

LINDEMANN, W. The Significance of Mineral Metabolism in Radiotherapy (Ueber die Bedeutung des Mineralstoffwechsels in der Strahlentherapie). (*München. Med. Wochenschr.*, 1918, LXV, No. 38.)

A number of cases of death have lately been reported in Germany which were due to injuries of the intestines by the roentgen and radium rays. It is evident that the mineral metabolism may play an important rôle in such cases. In the metabolism of the body the salts of iron and calcium are the most important. In the gastrointestinal canal iron is dissolved out from its compounds and absorbed as a salt or ion. The place of absorption is the duodenum. At the same time a part of the iron of the body is constantly eliminated. This elimination is performed by the large intestine. Thus iron constantly enters and leaves the system. The same may be said of calcium. The results of physical researches into the roentgen rays show that even very slight quantities of metal in the intestinal layers may exert a special effect on the cells. In this respect the amount of iron in the intestinal contents must also be taken into consideration. It seems therefore probable that the iron in the intestinal wall and intestinal

contents dispose to injuries of the intestinal wall itself. In practice it would appear advisable to empty the large intestine by enemas and to avoid iron medication before applying the roentgen rays.

WINTZ, H. A Centering Device for the Roentgen Treatment of Cancer of the Uterus (Eine Zentrierungsvorrichtung für Karzinombestrahlung der Gebärmutter). (*München Med. Wochenschr.*, 1918, LXV, No. 38.)

In the roentgen treatment of uterine cancer exact centering is the most important point. Only by exact centering is it possible to attain the necessary 110 per cent of the standard skin dose for the destruction of the cancer. By the compression tube, used by Wintz, the cone of rays may be directed to any point. But it is not so easy, even for an experienced man, to hit the vaginal portion, resp. the uterus from any side. To make this possible Wintz uses a tube of dark glass, 2 meters long and closed at one end. In the closed end there is a luminous disk covered with a mass which produces a bright light even with hard roentgen rays. This disk stands obliquely to the longitudinal axis of the tube and rests on lead which, at the margin, rises slightly above the surface of the disk. The mass fluoresces as soon as it is hit in a straight line by the roentgen rays. Lateral rays or rays coming from below are cut off by the lead. This tube is laid into the vagina and pressed against the vaginal portion. In lateral exposure the tube is turned so as to meet the cone of rays.

HAMMER, G. The Roentgenological Methods of Determining the Size of the Heart (Die roentgenologischen Methoden der Herzgrossenbestimmung). (*München. Med. Wochenschr.*, 1918, LXV, No. 4.).

The various percussion methods in determining the size of the heart are frequently insufficient (as in emphysema, in fat persons, great enlargement of the heart, etc.). The possible roentgenological methods are: 1. Exposure to the roentgen rays at a distance (Ferndurchleuchtung and Fernaufnahme). 2. The orthodiagraphic methods (orthodiagraphy and orthoroentgenography). These methods give us only an outline, a silhouette of the heart, and not the spacial dimensions of the organ. But the outline obtained permits us to draw conclusions concerning the dimensions of an enlarged heart. For determining the outline of the heart only three lines are important: the distance from the median line on the left, the distance from the median line on the right, and the longitudinal diameter of the heart. Among the methods of determining the outline of the heart the orthodiagram takes first place. Numerous experiments showed that the values obtained by roentgenography at a distance were on an average 1 centimeter greater than the corresponding values of the orthodiagram.

SCAINI, N. Roentgen Treatment in Ophthalmology. (*Riforma medica*, Naples, 1919, XXXV, No. 5.)

In the normal eye the conjunctiva shows considerable sensitiveness to the roentgen ray, the eyelids and periorbital tissues are much less sensitive, and the other tissues of the eye, especially the retina and the lens, are relatively insensible to the roentgen light. The roentgen treatment is valuable in new growth of the eye. In epithelial tumors, especially of the conjunctiva, the effect of the roentgen ray is the more rapid and intense, the more recently the tumor has developed. The first applications are the most efficacious. Epitheliomas of the eyelids and of the internal angle of the eye are easily cured with roentgen light. Epibulbar tumors (melanosarcoma of the limbus) have also been successfully treated in this manner. In conjunctival diseases (trachoma and follicular conjunctivitis) the roentgen rays are not superior to the other methods of treatment, but in vernal conjunctivitis they bring surprisingly good results.